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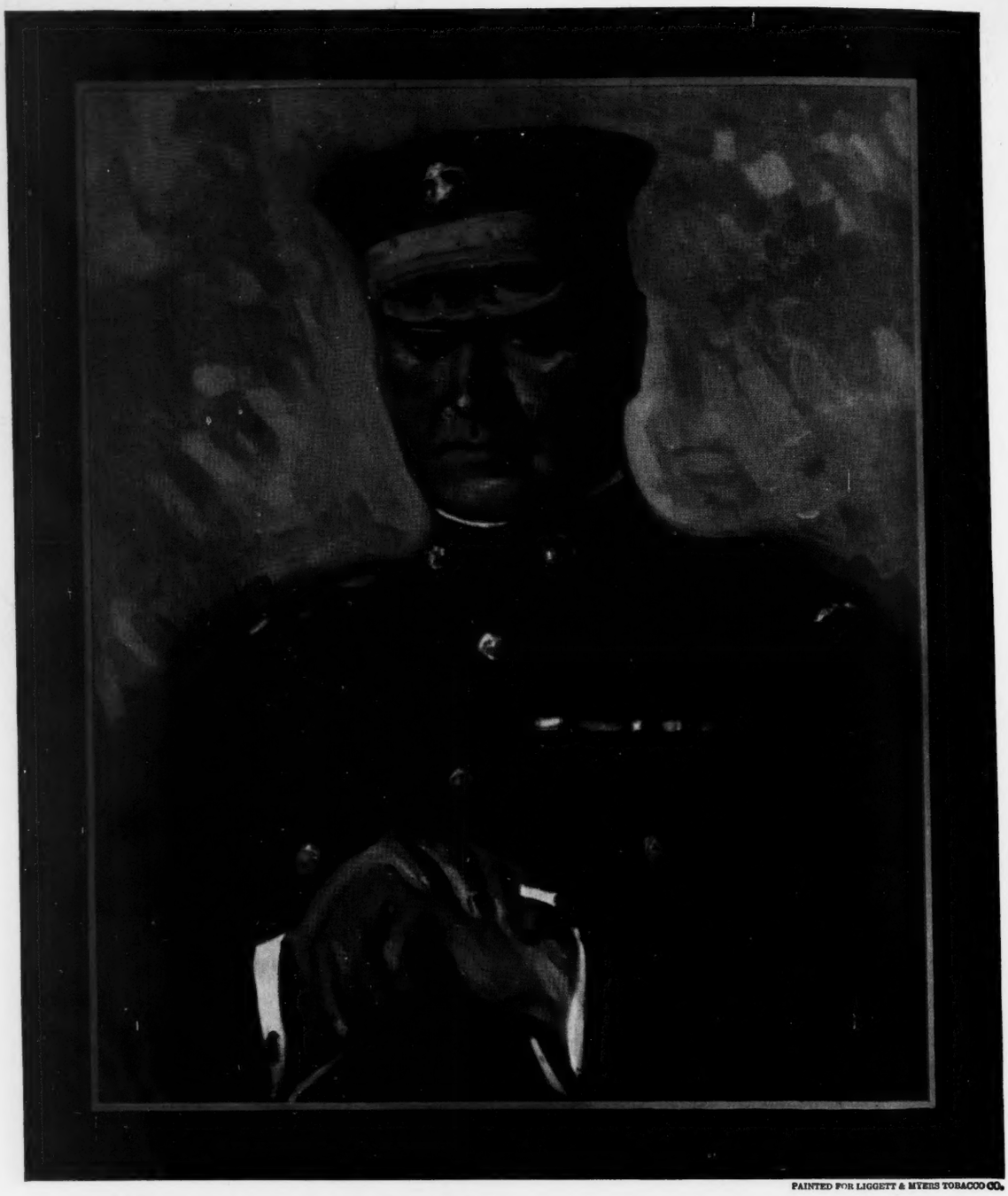

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Popular Science Monthly

Waldemar Kaempffert, *Editor*

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How to Beat Our Worst Enemy

Properly enforced laws would save the United States millions of dollars that now go up in smoke

By F. W. Fitzpatrick

The United States has the best fire-fighters in the world. But it has been estimated that about two thirds of the fires they have to fight could be avoided by more stringent laws properly enforced

© International Film Service

IN normal times Europe's fire losses average but one eighth or one tenth the loss suffered by the United States. One reason for this is that, under the laws of most European countries, a man cannot collect insurance for a fire originating upon his premises which the authorities can trace to his own neglect or carelessness. More than that, if the fire spreads to his neighbors' property, he is assessed, along with the insurance companies, for a proportion of their losses. All of this, of course, encourages carefulness in property-owners.

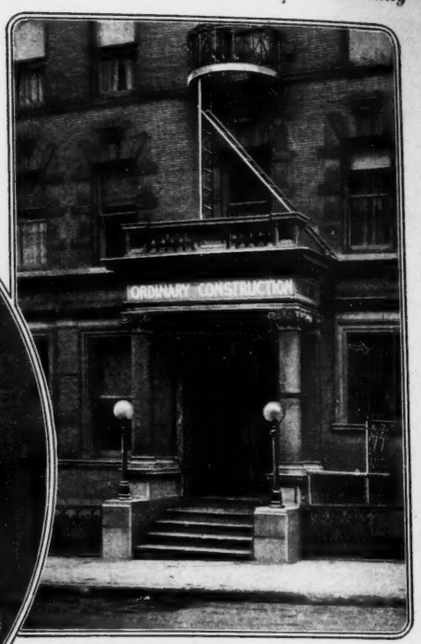
Half of the fires in the United States are the result of carelessness, and a great part of the remainder are nearly always traceable to arson; and the cost is more than $250,000,000 a year. But this sum represents only the fire losses in cities and towns where fire records are kept. Every year millions of dollars' worth of property of which there is no record goes up in smoke; for instance, in fires on farms or in other remote districts. Then, there is the cost of maintaining fire departments, the cost of high-pressure water supply, and the cost of maintaining insurance. In most of the larger cities the cost of maintaining fire departments is almost as great as the fire losses.

Our Terrible Conflagrations

All of these charges and losses might almost be called fixed or overhead, for they remain about the same year after year, in spite of the splendid efforts and actual accomplishments the United States has achieved in fire prevention. Yet one cannot call those losses "constant," for every few years there is a conflagration that boosts the

A landlord who could truthfully label his building "Fire Resisting" would have no trouble in getting all the first-class tenants he could accommodate

One plan for fire prevention would provide for the inspection of all buildings large enough to house twenty or more persons, and their labeling as to fire safety. The sign below needs no explanation



"Ordinary Construction" would mean reasonably safe; that is, not fireproof, but having the requisite sprinkling or other fire-fighting apparatus installed

average figures enormously. For instance, in the year of the San Francisco fire the fire losses were $580,000,000 instead of $250,000,000.

In the regular order of things this country is about due for another extraordinary blaze, the chances being intensified in cities where, in connection with war work, there is a great mass of temporary construction.

The terrible fire in Chicago in 1871 broke out in its lumber district, and, because of the fact that two thirds of Chicago's buildings were wooden, spread with great rapidity over the town. The flames even leaped across the river, destroying in all 17,450 buildings. The loss was $196,000,000, a fabulous sum in those days.

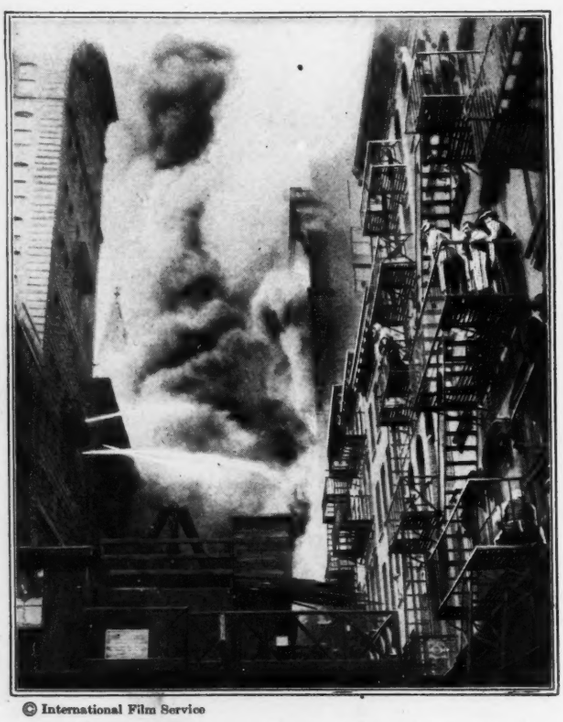
The fire that broke out in Baltimore in 1904 ate up the entire business section of the city.

The Biggest Fire

Right on its heels came the worst and largest fire in the history of the United States—the San Francisco fire of 1906. It broke out as a result of a series of California earthquakes, and raged for three days, tearing through the entire business section. The earthquake broke the water-mains, thus draining the reservoirs and making it almost impossible to fight the fire.

It was checked, finally, by dynamiting several houses. The insurance companies bore half the loss, which reached the enormous sum of $500,000,000.

These huge losses could have been avoided if the buildings had been truly "fireproof." Still people will build only as well as they are made to by law, so that every step of the way toward fire protection or fire prevention has been taken after a fight with the very people who should be most interested—the owners of property.



© International Film Service

From their fire-escapes they fearfully watch the blaze roaring in a paper warehouse only a few houses away

Since it is only by force that we can accomplish anything in that line, let's get still another law or ordinance through: the *labeling* of buildings. We have laws now as to just how buildings shall be constructed in this or that district, and it is the building commissioner or inspector who passes on the matter, interprets the ordinance, and is the authority in each city. Let us give him still another function: the inspection of all buildings of a public or semi-public nature—churches, halls, stores, hotels, apartment-houses, any building that houses more than twenty people under one roof. After these buildings are inspected they should be put in one of three classes and labeled.

Labels for Buildings

"Fire Resisting" would mean that the building is constructed according to all the requirements of fireproof construction; "Ordinary Construction" would mean that the building, though not fireproof, is reasonably safe and has the requisite sprinkling apparatus or other protection installed; "Dangerous" would point out the fire-traps. No law, no police, no terrible lessons would have half the effect upon property-owners as would this labeling. With "Dangerous" marked over his door, what chance would an owner have of renting his building?

You Cannot Waste Your Loaf and Have It Too

Twenty million tons of food for her starving people—this is the promise of the United States to Europe. That's a lot of food. If it were loaded into freight-cars, the cars would make up a train reaching from New York city to Spokane, Washington; and 1,594 locomotives of the huge triplex type, capable of pulling 251 fifty-ton cars, would be needed to haul it.

To transport this huge load to Europe, 240,000 tons of shipping will be kept busy for a year. The *George Washington*, which carried President Wilson to France, has a tonnage of 27,000; it would require a vessel nine times her size to take all the promised food over in one cargo.

Where will we get it all? The skyscraper loaf shown above suggests one answer. Formerly about 600,000 barrels of flour was wasted yearly in the United States in stale bread returned by the dealers to the manufacturers. The war put a stop to that. The saving, if put in one loaf, would cover a whole city block, and the loaf's crust would be level with the roof of a ten-story building.

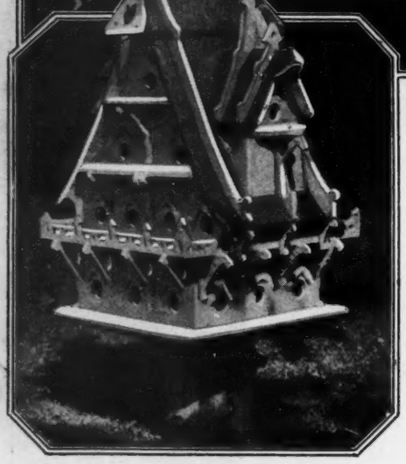
© Publishers' Photo Service

When It's Wash-Day in Bombay

WE in America are sternly warned against washing our dirty linen in public, but the people of Bombay do it shamelessly. On wash-day all the dhobies (a dhoby is an Indian washerwoman) meet at the dhobydom with their bundles of wash. This is a large, open, circular place down the center of which run long rows of wash-tubs.

Each dhoby selects a tub and starts her washing. The clothes are rinsed in smaller tubs just behind the wash-tubs, and are then hung on the arm of the tub to dry. When the clothes are dry the dhobies roll them into bundles and carry them home.

This system pleases everybody. The washerwomen are able to exchange the gossip of the town without interference, and the wash-owners are undisturbed.



Feathered Farm Help Live Here

THIS is a house that helps the birds that help the farmer raise big crops that help feed Europe. The birds that live in it are purple martins. They like the taste of the insects that like the taste of the crops, and by eating these insects they help to save the crops.

Although this martin house is made of wood, it looks like sugar candy. The candy effect is obtained by mixing white paint and sawdust to a creamy paste, and then spattering it over the house with a whisk-broom. The roof is painted green.

The birds work industriously for fourteen hours each day, after which they come home and rest up. Their natural home is in the hollow of a tree, but they are perfectly willing to live in man-made nests.

The martin is a kind of swallow.

A Fish Out of Water

BRITISH submarines are just as large and formidable as German ones, but they are not nearly so well known, for they live respectable submarine lives, while U-boats have made themselves notorious by their wicked deeds. This is a picture of a K-boat, one of England's best, which went aground on the Lancashire sands in one of the fogs that so frequently hover over England. The boat's length is 350 feet.

© Kadel & Herbert

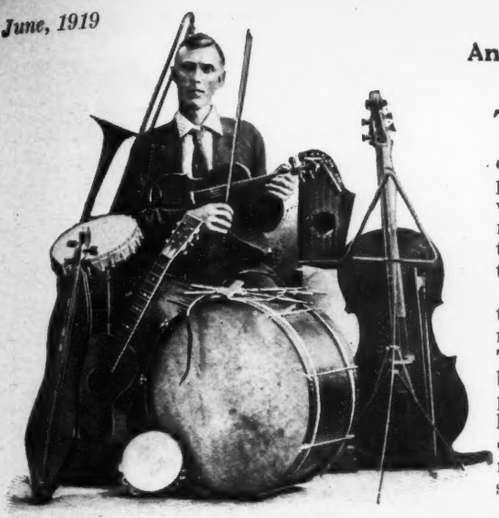
The Watch that Wore a Gas-Mask

IF the Germans had had a better sense of efficiency and had spent more time on the things that really counted, they might have fared better. For instance, many German officers wasted hours hanging on their dug-out walls curtains and "God Bless Our Home" pictures which were not at all appreciated when they were captured by the Allies.

One careful German soldier had a gas-mask made for his watch. This energy was wasted, for the watch is now in America.

The gas-mask is simply an outside case—one face of it glass so that the time will show through it—which fastens tightly about the watch and allows nothing to go in or out.

Of course a watch does not need a respirator, nose-clip, mouthpiece, or chemical-box.



An Expression of Patriotism from the Vegetables

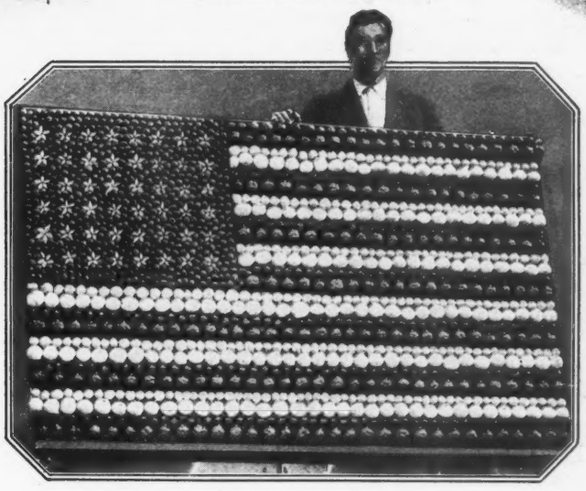
THREE cheers for the red, white, and blue—in this case peppers, onions, and plums. The red peppers and white onions are lined up to make the stripes; the field for the stars is blue plums, and the stars are white plums.

Long may it wave? Alas, there lies the trouble. It can neither last long nor wave. The vegetables were beautiful, brilliant, and good when this picture was taken, but before long they will go bad. If the owner is wise he will sell his red, white, and blue stars and stripes before they turn brown.

He Plays Them All—and Never Had a Teacher

"PROFESSOR" Monroe, of Montour, Mo., feels a justifiable pride in the fact that, though he has never taken a single lesson in music, he is proficient on no fewer than nine different musical instruments. Although he is a self-made musician, the Professor gives lessons on all of the instruments he plays.

This ability is not altogether due to native talent, but in a very great degree to constant practice. He is still adding to his repertoire.



Every Korean His Own Blacksmith

IF a Korean horse were asked whether he wished to go with or without shoes, he would undoubtedly jump at shoelessness, for being shod in Korea is much worse than sore feet. The horse is turned over on his back, his feet are tied together, and then all four are tied to a pole.

While the horse lies in this uncomfortable position, his owner leisurely hammers on the shoes, while the son of the family hands him the nails he needs.

How Indians Make a Silo for Acorns

IN California the Digger Indians have a primitive but most effective way of storing up the acorns they use for making their bread during the winter months. They use what is called the acorn-basket.

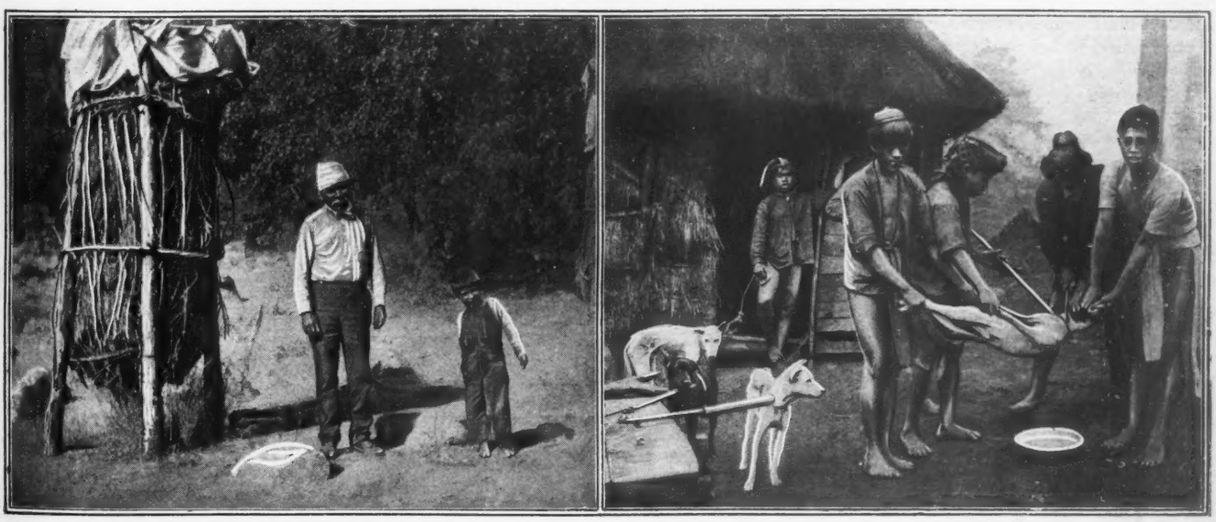
The Digger drives four stout posts into the ground, and puts three or four withe hoops around them, forming a sort of barrel frame. Limber pieces of brush are then worked in as barrel-staves, and when these have been made almost rat-tight a second layer of finer brush is used to line the basket. The Digger then pours into the basket his supply of acorns, and fastens an old piece of burlap over the top.

Thus protected, the acorns are safe from squirrels, blue-jays, and other denizens of the woods.

Is This the Original "Hot Dog"?

THERE is such a thing as a hot dog. It is not found trimmed with mustard on a roll at Coney Island, but in that far-distant part of the United States known as the Philippine Islands. The gory picture below shows only too clearly how a hot-dog feast is prepared. It is presumed that the three patient-looking animals tied up at the left will be the next victims. Such pictures as this in large quantities would surely boost vegetarian stock.

The Filipinos are not the only people who eat dogs, for dog meat has a pleasing taste. It resembles veal, though it is somewhat stronger. One reason for this may be that the action of a dog's digestive system is very rapid. This would, most likely, affect the taste of the meat.



Invention *versus* Death—to a Finish

It was a close fight, but once more mind triumphed over matter

By Theron W. Bean

A third bolt crashed down on the decks of the *Dumaru*

HEAVY black clouds hung like a pall over Guam as the United States Shipping Board S. S. *Dumaru* slipped out of Apra harbor, bound for Cavite, P. I., carrying a government cargo of high explosives. The vessel had hardly left the island before a terrific electrical storm broke. Out of the heavens crashed a bolt of lightning, striking far out in the sea. Another struck farther in. Then came the fatal blow, as the third bolt crashed down on the decks of the *Dumaru*.

In a few seconds the entire forward part of the ship was in flames: the gasoline stowed in the forward hold had been ignited. With the gale against which the ship was steaming, it would be but a matter of minutes before the cargo of munitions in the after-hold would be set off.

Knocked Out by Lightning

"Abandon ship!" came the order.

The men rushed to the decks and the launching of the life-boats began. My post was the radio cabin. The distress signals were soon on the ether with good radiation. Any station within fifteen hundred miles of us could be expected to pick up the call. But as I threw my switch into a receiving position another bolt of lightning struck out the antennae. Its charge was carried down into the receiving tuner. Since the safety gap was not heavy enough to stand the charge, the receiving apparatus was burnt out. At the same time a "short" through my telephones keeled me over; but I was soon able to resume sending, as the transmitter had not been damaged. I was compelled to leave the cabin as the flames broke in at the rear.

Upon reaching the deck, I saw but one life-boat, about twenty-five yards away. Jumping over the side, I swam to it, and was crowded in among thirty-one other men who had been the last to leave.

Drifting a Thousand Miles

As quickly as possible our boat was rowed away. When nearly a mile separated the flaming *Dumaru* from us, the crash came. High into the air the hull was sent, breaking into gleaming fragments under a blood-red sky. Several hours later we stopped rowing and crawled under the sail to shiver through the night.

Toward morning rowing was resumed, and just at dawn Guam was sighted. But a change of wind occurred, and this, with the four-mile current that runs off the island, forced our life-boat away. Another disappointment lowered the spirits of all on board. A steamer was sighted, and at once the men shouted: "She's looking for us. We're surely safe now!" Being the youngest and lightest, I was sent up the mast to wave a red shirt; but frantic waving and shouting availed nothing, as she kept her course and soon passed out of sight.

"It's a question of time now, fellows," said an ensign. "We must row and wait for the time when the wind will change, or a pick-up may save us."

But neither did the wind change nor the relief come. Our water supply was found to be low, and so was the amount of hardtack. Two tablespoonfuls of water and one hardtack a day were our rations. How long we could last on this no one dared to think.

After a week of terrible suffering—a week in which we all gradually grew weaker—we found it would be useless to attempt to make Guam. Against the judgment of a few, the course was laid for the 1,300-mile drift, to the Philippines.

The Life-Giving Still

As the days passed the water-tanks became more nearly empty, the hardtack scarcer, and the men in worse condition. Finally our negro cook became disheartened, gave up completely, and was soon insane. For three days he alternately prayed and cursed, vowing he would never live to pass the thirteenth day. This superstition seemed to hasten his death, and he did die on the thirteenth day out. On this same day our supply of water became totally exhausted.

From the seventeenth day the deaths came rapidly. On the seventeenth day after the wreck the last wormy hardtack was choked down. With no water and no food, something had to be done if any of us were to be saved. Surrounded by salt water, the tempta-

All the difference between life and death hung on the success of the engineer with the bent pump-rod as a fishing-gaff

To distill a few drops of life-giving water in the hastily fashioned evaporator even the gunwales of the boat were cut down and used as fuel

tion to drink it is maddening. Those who could not resist died quickly.

Then some one suggested evaporating the salt water. An empty hard-tack container was connected, by a pipe torn from the bailing-pump, to an empty water-tank. Filling the hard-tack tin with brine, we generated steam by building a fire under the tin in a bucket. First the oars were used for fuel. But the oars soon burned away, and almost no steam was condensed. Failure meant death. Then we remembered our shoes, and these were added to the fire. In this manner, enough fresh water was evaporated to give each man a swallow.

The next night our lips were again swollen and blackened. Our chances of life were so slight that nobody objected to the suggestion that the freeboard of the boat be used for fuel. Again we succeeded in getting a sip of water.

Dolphins had been following the boat for many nights. One of our engineers believed it possible to catch one, if the means were at hand. So a bailing pump-rod was heated in our fire, and bent in the form of a gaff. With this hook the engineer succeeded in landing three dolphins, each weighing about fifteen pounds. The first, boiled in salt water, was inedible. The others were rationed out in small pieces and eaten raw. Sufficient moisture was obtained from the raw fish to take the place of the water we so sadly lacked.

Death Reaches Out Again

Twenty-four days had passed, and we had seen no ships, had no rain to give us water, nor sighted land. Then about noon a shout went up from one of the men. Land was sighted. As each man assured himself of the truth of this, it dawned upon us simultaneously that we still had a chance to live.

About four o'clock the rocky coastline of the island toward which we were being carried became more distinct, and a sandy beach could be distinguished. The boat, caught by current and tide, was swept toward the beach. One danger remained; the craft must pass through a heavy surf. Each man held his breath as the first breaker caught the boat, lifting it high and carrying it shoreward. Six hundred yards more, and the beach would be reached.

Just as we felt sure of setting our feet safely on ground, the boat was caught by a tremendous torrent of water and tossed end over end, throwing its sixteen occupants on the coral reef on the jagged edges of which the boat had capsized. Pounded and thrown about by the surf, we finally reached the beach, torn and cut by the poisonous brown coral. Two of our number were unable to make the fight through the heavy surf, and their bodies were washed out to sea.

We fourteen survivors knelt down on the beach and gave thanks.

What It Costs to

The average family (five persons) in New York city has to pay about one hundred dollars a year in additional rent and other expenses for the privilege of living on an island

The Equitable Building stands upon an acre of ground, but it has more than forty acres of floor space, thirty-eight stories above-ground and three below. It is the largest (though not the highest) office building in the world

Manhattan Island is connected with New Jersey and Long Island by five bridges and seven tunnels. The congestion due to the water barriers has heaped the population literally sky-high downtown. The average farm of a hundred acres brings in about the same income as that from the rent of a piece of land in lower Manhattan equal to the area of the two desks below. There are about a hundred acres below the dotted line in the picture above

The ground-space occupied by these two desks, each thirty-two by fifty inches, is worth $13,000. The interest on this at 6 per cent would yield an income of $780 a year, or about that of the average hundred-acre farm

Some items in the yearly expense account of the bridges are: cost of operating surface and elevated cars, $2,600,000; value of time lost by vehicles in approaching and crossing bridges, $2,500,000; maintenance and repairs, $720,000; depreciation, $580,000; interest on capital, $4,050,000; administration, $120,000; total for four bridges, $10,570,000. Total for all bridges (estimated), $18,000,000

The first cost of the Hudson and Manhattan tunnels was $55,000,000; that of all the tunnels in operation today, $200,000,000. Passengers in Hudson tunnels (1914), 60,000,000; fares from these, $3,500,000. Estimated fares for all seven tunnels now in operation, $10,000,000

New York's Five

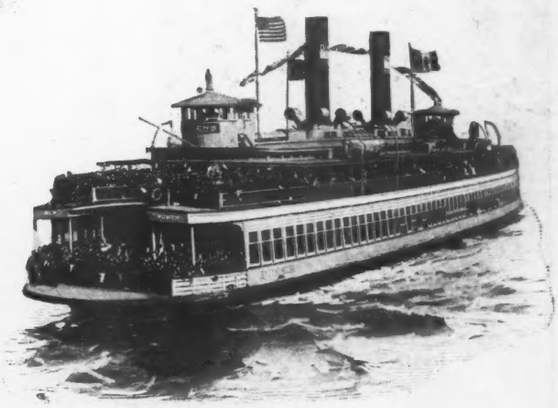
Of the world's longest bridges five are in among suspension bridges, the Brooklyn, hold the world's record. The Hell Gate

Live on an Island

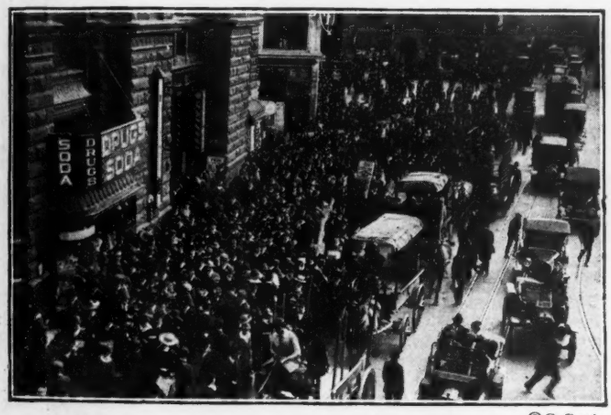
© Success Postal Card Co.

The cost of living on an island, itemized:

Cost of municipal ferries,	*$2,230,000*
Fares on other ferries,	*$3,840,000*
Vehicle fares,	*$4,000,000*
Cost of delays,	*$4,500,000*
Total cost of ferries,	*$14,570,000*
Cost of ferries,	*$14,500,000*
Cost of bridges,	*$15,500,000*
Cost of tunnels,	*$10,000,000*
Total cost for personal conveyance alone,	*$40,000,000*
Estimated cost of river crossings for freight,	*$10,000,000*
Total cost of river crossings,	*$50,000,000*
Cost of extra rent due to congestion,	*$50,000,000*
Grand total,	*$100,000,000*



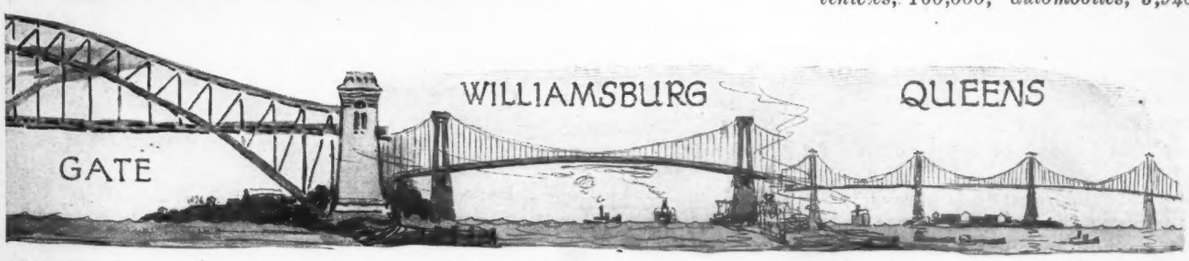
In 1906, when the ferry traffic in New York city was at its greatest height, there were in the service 152 boats, or 28 per cent of all the ferry-boats in the United States. They carried in one year 209,000,000 persons, or 63 per cent of all the ferry passengers in the United States. Since then increased bridge and tunnel facilities have somewhat relieved ferry traffic



© C. Curtis

Park Row at 5:15 P.M. More people are said to pass this spot, which is near the entrance to Brooklyn Bridge, than any other in New York, and at going-home time they seem to be all trying to pass the same spot at the same moment

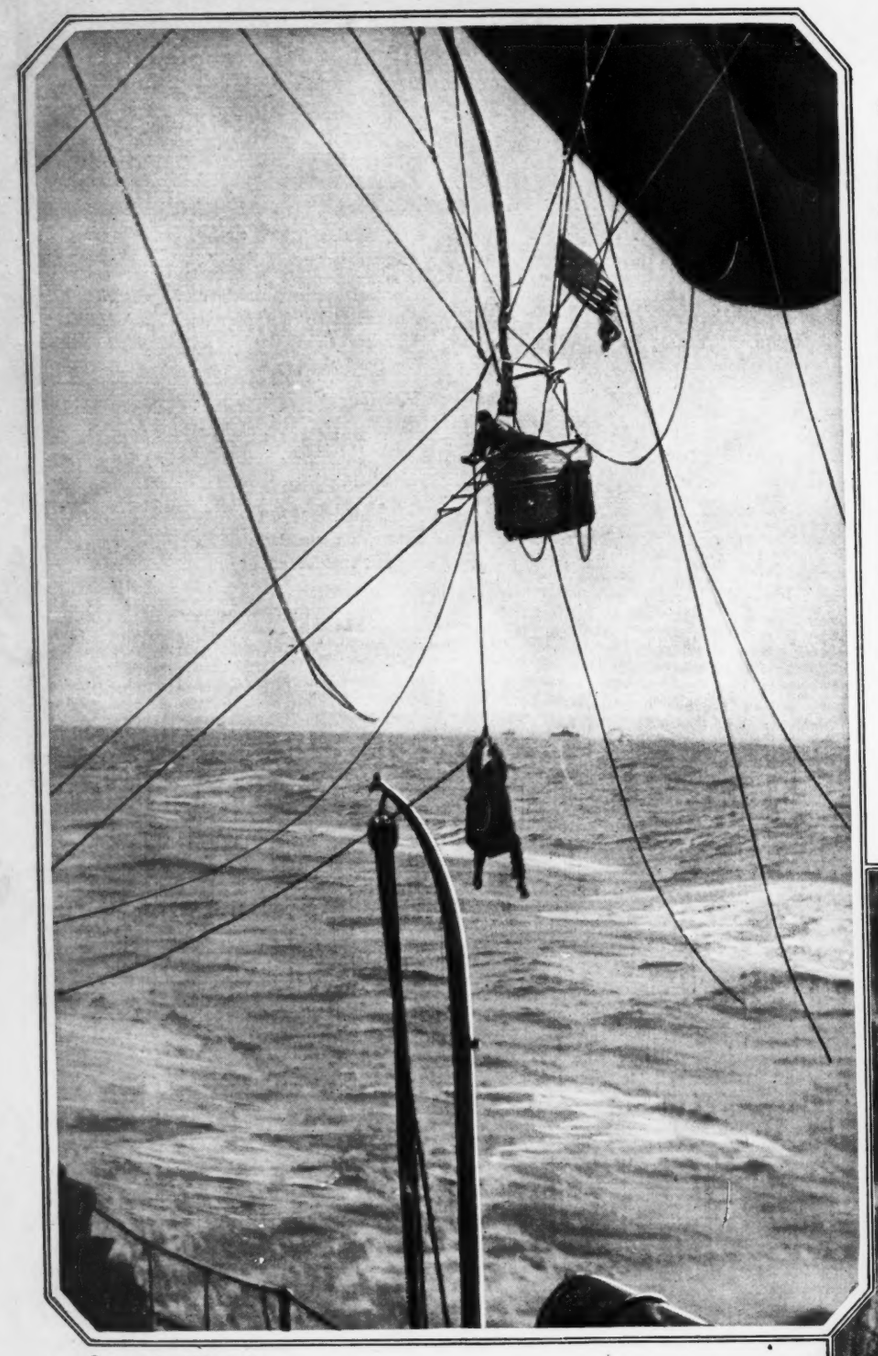
The traffic across the four older bridges in one year is approximately: foot passengers, 6,000,000; trolley-car passengers, 130,000,000; elevated train passengers, 115,000,000; one-horse vehicles, 2,400,000; two-horse vehicles, 1,600,000; three-horse vehicles, 160,000; automobiles, 3,940,000



Great Bridges

New York city. For length of span Manhattan, and Williamsburg bridges Bridge is the largest of arch bridges

The length of Brooklyn Bridge is 6,016 feet, its longest span, 1,595 feet; Manhattan Bridge, length 6,855 feet, span 1,470 feet; Williamsburg Bridge, length 7,308 feet, span 1,600 feet; Queensborough Bridge, length 7,449 feet, span 1,182 feet; Hell Gate Bridge, length 18,000 feet, span 1,017 feet



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By a breeches-buoy arrangement, the crew of this giant observation balloon towed from a steamship is able to shift at will from the basket to the deck

Dropping the Pilot—1919 Version

HANGING in midair, this daring man is one of the crew of two of a great observation balloon which has been towed above a ship to give a gull's-eye view of the steamship track, lest any vagrant mine cause a post-war disaster. It is something of a job to haul down one of these balloons, and so they change watches in the basket by sending men from balloon to ship or from ship to balloon by this breeches-buoy arrangement.

If this exchange of men is possible with a captive balloon, why isn't it possible for a dirigible, say of the "blimp" type, to sail over a steamship, drop a mooring-line aboard, send down a breeches-buoy tackle, and transfer a man from blimp to steamship? And why shouldn't that man be a pilot, ready to show the ship the way into port while the blimp pilot-boat-wise sailed on to deliver pilots to other incoming vessels?

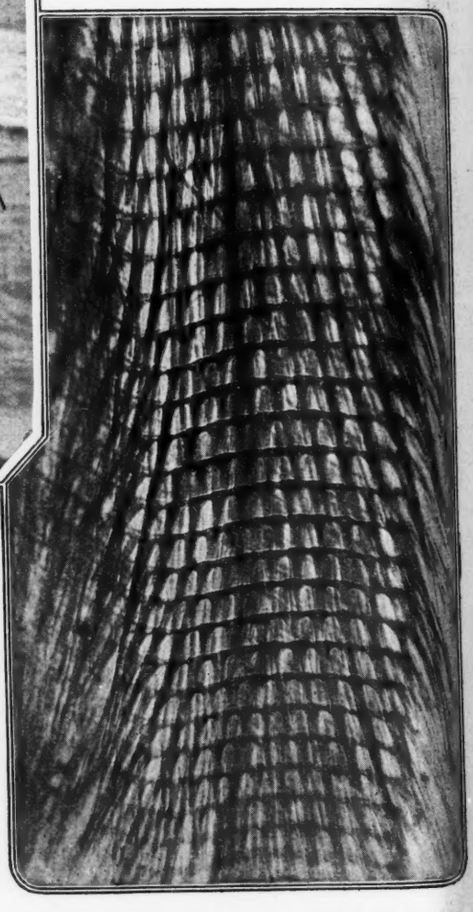
The Beautiful Tongue of a Honeybee

THE tongue—or, more strictly speaking, the glossa—of a honeybee is covered with long hairs which increase in length toward the end of the organ. These are arranged in circles and in transverse rows, and give the tongue a beautiful appearance.

Some authors believe these hairs to be taste organs; but it has been suggested by good authorities that they are simply spines guarding the tongue's delicate tip.

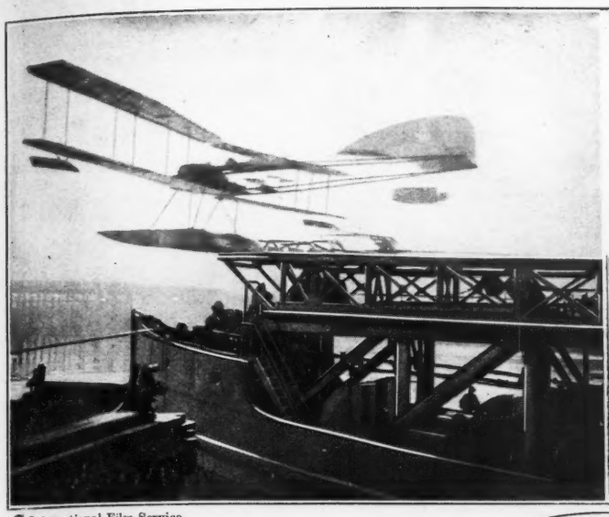
Give some bees a small amount of honey and then watch them through a lens while they are eating. This may be done by placing a little honey on one hand and holding the lens in the other. While one may thus see the motions, it is in the main difficult to observe in detail exactly how the work is done; and here, as with the sting of the bee, there are some differences of opinion. The action seems to be a combination of capillary attraction, sucking and lapping.

The tongue is not a solid organ, nor yet is it truly tubular. It is so curved that, in connection with the hairs, it is either wholly or partly converted into a structure that acts like a tube.



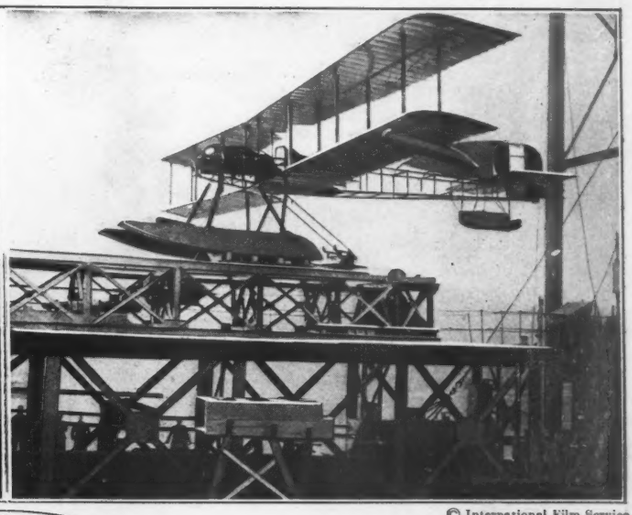
Honeybees have hairy tongues. Naturalists differ as to whether the hairs are little taste tubes or simply a guard for the tender tongue-tip

Shooting an Airplane from a Sling



© International Film Service

This British scheme for launching an airplane from a ship was a secret during the war: it is essentially the same as Langley's which Captain Chambers perfected



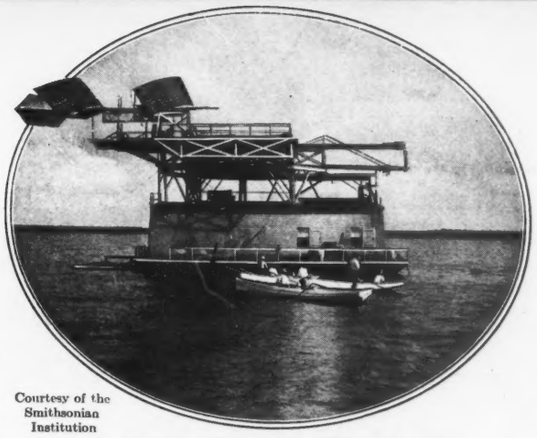
© International Film Service

Here the seaplane is shown ready to be shot along the launching rails by a compressed-air catapult. Years ago, Langley used coiled springs for the same purpose

THE great-grandfather of the present engine-driven airplane, Langley's aerodrome, or rather a quarter-size model, first flew in 1896. Later he built other quarter-sized models, and they all flew. He solved the problem of getting his flying-machine afloat in the air ocean by hurling it from the roof of a house-boat. He placed the airplane on a car which was propelled by springs along short rails, and at the end of its run stopped abruptly, thus shooting the airplane off into the air. With this kind of a start, the Langley model flew one thousand feet in twenty-one seconds.

Langley did not succeed so well in launching a man-carrying plane by this method, and later pioneers in the art learned to run their machines along the ground until they got up speed enough to jump them into the air, much as some of the heavier birds have to run a short distance before taking flight.

But in order to get up enough speed to lift the airplane from the ground into the air large and comparatively smooth fields—or, in the case of hydroplanes, stretches of quiet water—are needed for the running start. To get into the air from narrow quarters, such as a ship's deck, fliers had to go back to Langley's plan. How closely the most recent attempts to launch airplanes without the aid of broad flying-fields resemble those of Langley is shown in the pictures above.



Courtesy of the Smithsonian Institution

Langley's man-carrying plane as it appeared just before a trial flight in 1903

Langley's machine weighed about 640 pounds; the seaplane weighs about two tons. Langley hurled his machine along the launching track by the thrust of the airplane's own propellers and the pull of a powerful coiled launching spring of great power. The British seaplane is shot along the rails by a compressed-air catapult. The parallel between the Langley experiments and the British is made all the more striking by the fact that, while it was a quarter-size model that Langley flew successfully, the British in their attempt did not care to risk a man in the machine that was to be shot into the air, and so both machines fell after short flights.

In our own Navy Captain Washington I. Chambers made successful experiments in launching airplanes from a ship's deck several years ago. More recently, airplanes have been launched from runways built across a battleship's deck and outboard along the barrels of the great guns, thus giving the airplane room to get a running start; but the problem, so necessary to commercial as well as to war needs, of launching airplanes from narrow quarters is still to be solved. And coupled with it is the still more difficult one of landing in a restricted space.

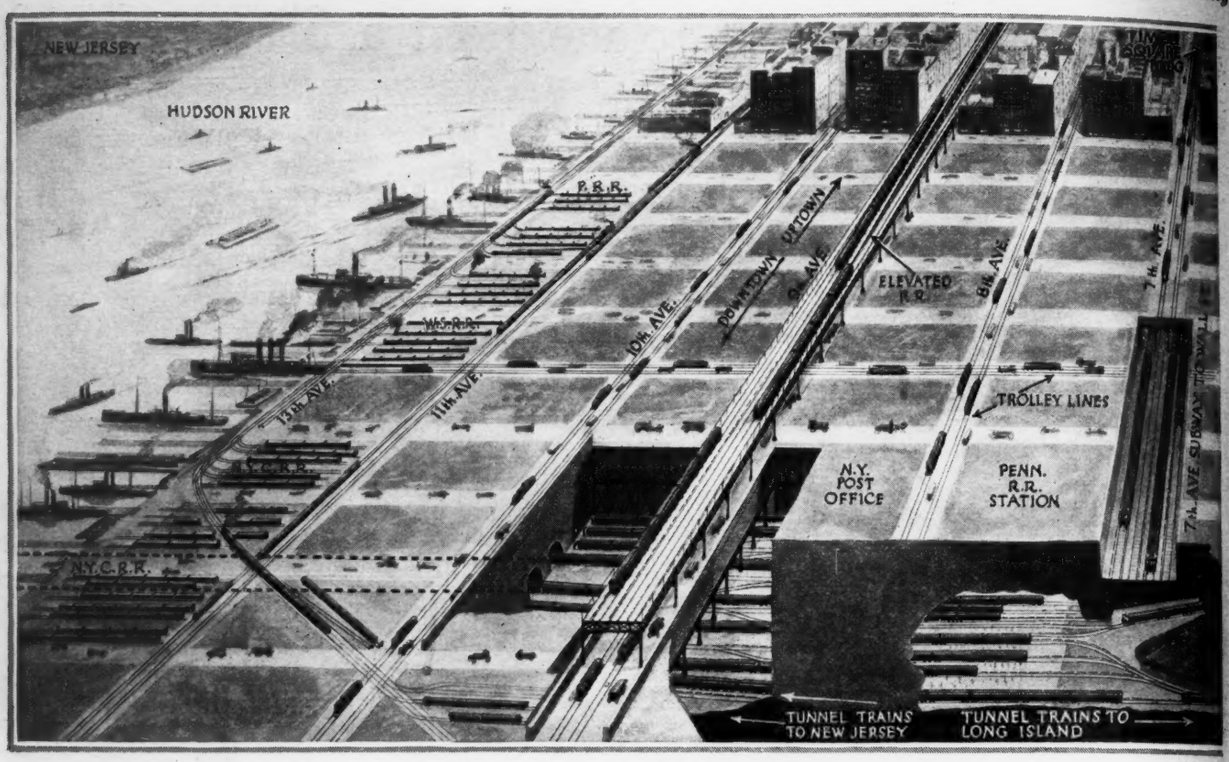
Promoted from Stable to Mansion

BACK in 1853, a rich New Yorker built a fine stable of granite at the northern end of Manhattan Island. Following the prevailing architectural fashion, he built his stable with an archway through the center. Upstairs were living quarters for the coachmen.

Now comes another New Yorker who purchases the old stable with the surrounding ground and converts it into a mansion. The archway becomes a spacious reception-hall; the space formerly occupied by the stalls is now a living-room, dining-room, and closed-in porches; the upper floor is used for bedrooms.

© Publishers' Photo Service

Of course it was a beautiful and commodious stable; its present occupants are as comfortable as the horses once were



At the same time that New York was building skyscrapers in which to house its millions of workers, it was burrowing into the earth, building stories below-ground in which to run the long trains of cars that carry the workers to their work

The Roads that New York Travels

Because the town lives in layers and

By Travis H. Whitney, of the Public

NEW YORK is the tallest building in the world: its sub-cellar is far below the surface of the earth, and its roof in some places reaches up 750 feet above-ground—and New York is constantly growing taller. For, as congestion increases, engineers bring relief by digging deeper and building higher—always adding to New York's many stories.

Though there are 360 square miles in New York city,—an area large enough to furnish one city lot to every family in New York,—almost all the business of making money takes place in the section from Times Square down to the Battery and from river to river on the sides. So that every morning at about nine o'clock more than a million people pour in, not only from the 360 square miles of New York city itself, but from near-by New Jersey and up-State New York, and then rush out again between five and six—all in a great hurry, all impatient at the slightest delay.

Taking a Million to Their Work

It was the need for accommodating this million of money-makers that brought the high buildings for them to work in and the layers of underground subways and tunnels for them to travel in.

Down in New York's present sub-cellar are the tunnels that run off Manhattan Island into the river-beds on either side and then on to New Jersey and Long Island.

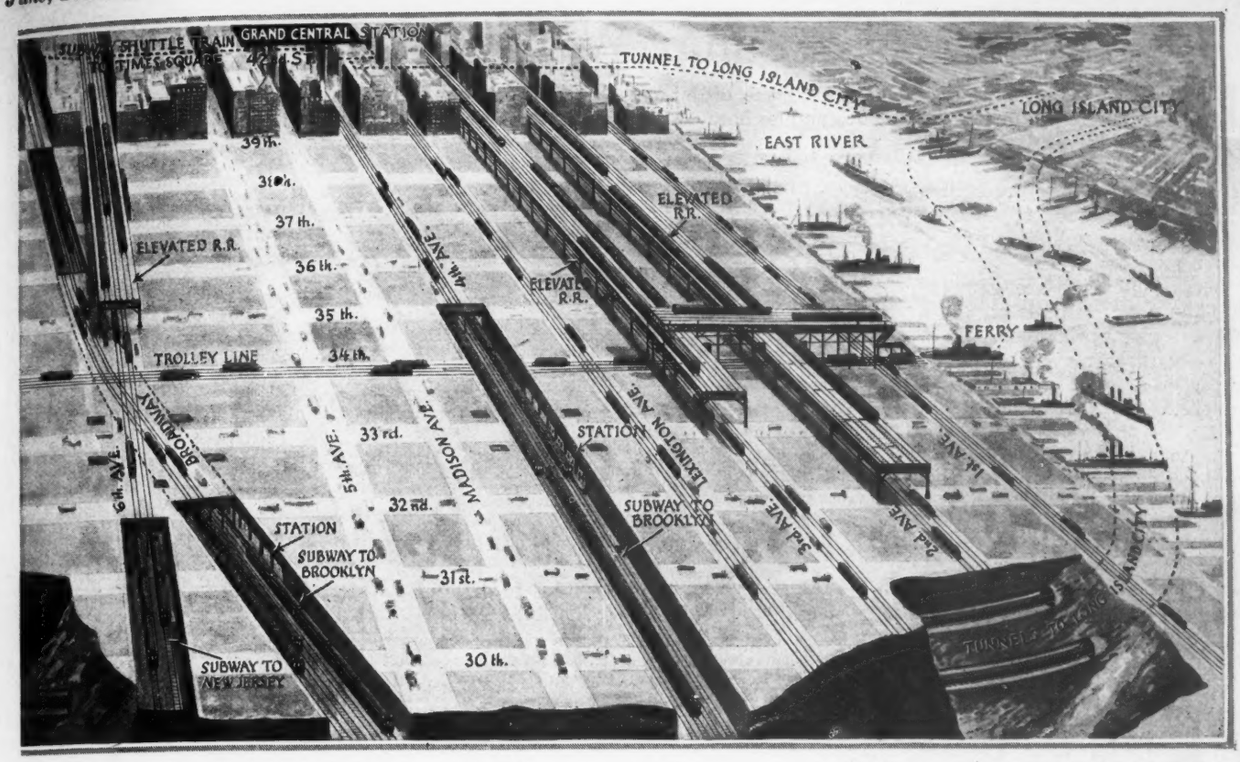
In building these tunnels under the rivers, the workmen sometimes had to dig through rock, sand, and silt, and they constantly ran the risk of having the water break through. Yet the tunnels were so well finished that the commuters who travel through them today seldom know or care whether they are reading their newspapers below the bed of the river or merely under the skyscrapers. A suspicion of dampness, a slight pressure in the ears, and some extra noise are the only differences, for the subway passenger, between life under the river and life on land.

One flight up from the tunnels are the subways. They were started back in the nineties to help out the overcrowded street-cars and elevated trains which struggled along above-ground. The first system that ran from Brooklyn to Ninety-sixth Street and then branched off into two lines—one destined for Washington Heights and the other for the Bronx—solved the problem of the nineties. It cost more than $55,000,000, and accommodated 400,000 people a day. The trains ran two minutes apart at the rate of thirty miles an hour on both local and express tracks. They were—and still are—made up of ten steel cars coupled together. Seen from a distance at night, one of these trains as it nosed out above-ground looked like a giant caterpillar speeding along.

The New Subways

This subway system, which was adequate for New Yorkers in the nineties, would not satisfy the people

First, in the many stories that make up with its labyrinthine structure far underconstituting another story. Above them runconstruction in some places, or two stories high. each day as on the entire Pennsylvania Rail-2,915,200,205 passengers were carried on the accident—a record unequaled by any other one of New York's Public Service Comarticle how very much more wonderful is the the old-world cities at which the ancients



Above the tunnels come the subways, then the trolleys, and then the elevated railroads. The tunnels burrow under the rivers and come out in Long Island and New Jersey, where they gather in the commuters and bring them to Manhattan

Make It a City of Many Stories

works in layers it must also ride in layers

Service Commission of New York

New York's traction lines, there is the subway ground. Then there are the surface lines, ble trains of the elevated railway, of double-deck Twice as many persons ride on the subway road system. During a period of ten years subway, of whom only one was killed in a train railroad in the world. Mr. Travis H. Whitney, missioners, reveals in the accompanying metropolis of the New World than any of once marveled. THE EDITOR.

of today—there are so many more of them. Last year passengers were jammed in the trains until the doors would barely shut. And so the old subway, which wandered at Forty-second street from the lower East Side to the upper West Side, was cut in two, and each half extended up its own side of the island. They go their separate ways, and are connected only by a shuttle train.

This change in New York's subway route has added 330 miles of tracks at a cost of $330,000,000. Meantime the Brooklyn Rapid Transit system has helped out by crawling up to Times Square.

All of this digging for subways and tunnels had to be done under buildings and under streets that carried heavy traffic, so that one third of the many millions which the subways cost was spent for bracing up buildings and streets to keep them from falling in.

Some Difficulties of Construction

Here is an example of the difficulties encountered: William Street is forty feet wide, and the subway built under it was to be thirty-nine feet six inches wide. In the first place, part of the subway was below the water-level, and the diggers bumped into dangerous quicksand pits. Then, after they had dug across the street and approached the opposite side, they hit the foundation of a building which jutted out into their thirty-nine feet six inches. Whereupon they moved back the foundation before they continued.

Though each new system of the under-world took away some of the trade of the trolleys and the elevated railroads above-ground, they continue to thrive, keeping up to the times by dropping their respective horses and locomotives and taking up electricity. And the elevated lines developed third tracks for express service.

In third-tracking the elevated, whole sections of tracks had to be raised, a few inches at a time, while the traffic continued as usual. No one was hurt, and yet at any time the slightest mistake in plans or defect in structure might have endangered the lives of hundreds.

One of the interesting features of construction, from an engineering point of view, is the hump, or grade, at the express stations. As a train approaches a station, the up-grade makes stopping an easy matter, while the downward inclination on leaving the station gets up speed very radidly.

All together there are twenty-three different ways of traveling from Fifty-ninth Street to City Hall; and downtown, where the city narrows, there is at least one railroad to every lengthwise street. With all these four layers of trains working at top speed, the city today is just about able to hold its own.

It was through this development of New York's third dimension that New York is what it is today. People work in layers, and people ride in layers; and whenever more room is needed the city simply builds an extra story.

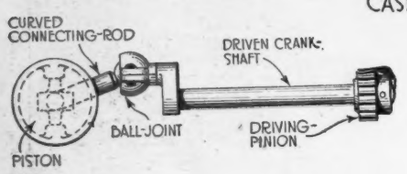
A New Tire Pump Without Any Valves

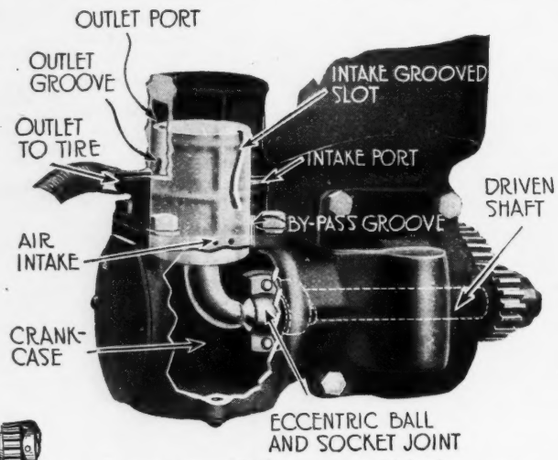
TROUBLE is sometimes experienced with the ordinary type of air tire pumps fitted on automobiles because of the multiplicity of parts such as valves, valve springs, piston rings, spring check-valves, and the back pressure unavoidable in such types of pumps when pumping against a high resistance.

These difficulties are eliminated in a pump built on an entirely new principle. It has only three moving parts, the piston, the connecting-rod, and the driven crank-shaft.

The valves and check-valves are done away with by ports cut in the piston in somewhat the same manner as in the early forms of two-cycle gasoline engines. The piston ports or grooves are made to register with other passages in the cylinder casing, as shown, to admit and discharge the air after compression by giving the piston an oscillating or turning movement about its vertical axis as well as the ordinary up-and-down motion.

This combined double motion is secured by the employment of a connecting-rod with a curved lower end and a ball-and-socket joint between it and the driving crank-shaft. The axis of the ball-and-socket joint is offset from the axis of the driven crank-shaft. This eccentricity provides the throw necessary to give the piston its stroke. This is clearly shown in the sketch giving a plain view of the moving parts.





A new type of tire pump which does away with valves, springs, etc., has only three moving parts—piston, connecting-rod, and crank-shaft

It Makes Life Easier for the Delivery-Man

NO doubt all of us have wondered why the milkman, the baker, and the iceman still continue to use horse wagons. Ask the milk, bread, or ice companies, and they will tell you that the truck does not pay in house-to-house delivery work because there are so many stops in a block that the truck is in actual running operation only for from five to ten per cent of the total time of the trip.

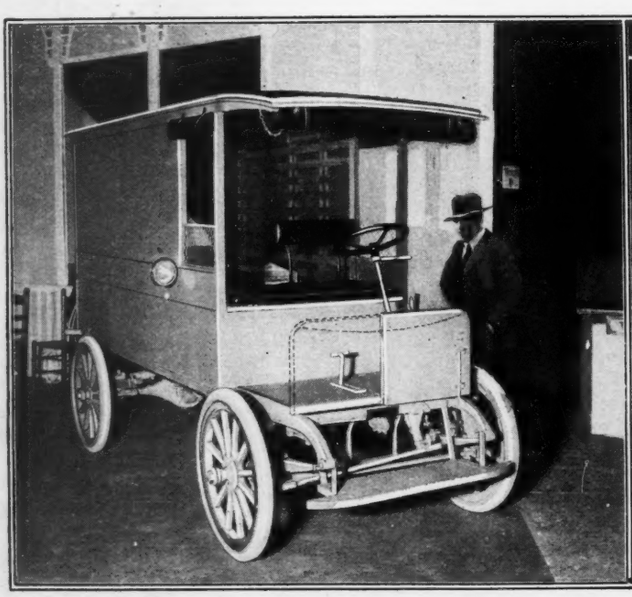
Electric cars, which are more economical in such work under average conditions, have been employed to some extent. To make them still more efficient, one maker has brought out a vehicle with a front step ahead of the forward wheels and a hinged dashboard. The dashboard may be swung out of the way so that the driver can get on and off in the least possible time.

In an Emergency This Truck Operated a Bakery

RECENTLY, at the beginning of a railway strike in Kansas City, Mo., the city was without electricity for power.

One enterprising bakery firm put a car in to run its power plant, but the differential of the car went bad in about two hours. Then a truck was put on the job. The rear wheels were jacked up and a belt run from the tire to the shafting overhead. The truck ran the power plant for seven hours straight with no differential trouble, and the radiator not even boiling.

This proves that the truck of today is an efficient and economical worker. From all parts of the country come tales of the various jobs it undertakes that are entirely out of its line of work; and usually it pulls out a winner.



The hinged dashboard folding back with a step below allows the driver easy entrance through the front of this electric truck

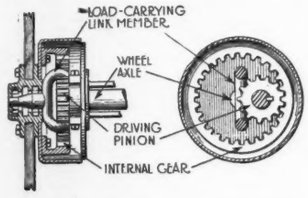
Just as if it were out delivering bread, this truck got on the job when the power gave out and ran the bakery's machinery

An Akron inventor has brought out a new type of axle that converts a passenger-car into a commercial vehicle

The Little Axle Does It

WHENEVER a passenger-car is converted into a vehicle to carry a greater load, it is necessary to increase the final gear ratio between the engine and the rear wheels. The driving gear on the car drive-shaft must be made very small or the driven gear made so large that the axle casing to inclose the gear has not sufficient clearance from the ground.

C. R. Baker has invented an axle in which the load-carrying member is formed with a hollow link, inside of which the driving pinion may project, as shown in the accompanying illustration, to give any desired ratio between the teeth of the two gears.



The driving pinion of the axle projects from a hollow link, giving any desired gear ratio

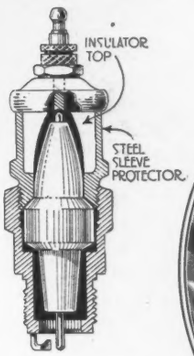
A Spark-Plug that Can't Break

A NEW type of plug has a ventilating chamber surrounding the shoulder and upper part of the insulator, with two vent-holes to draw off the superheated air and permit a circulation of cool air.

The insulator is vitrified silica and lava. It is claimed that this insulator will withstand the most violent temperature changes without breaking.

Any wrench will suffice to take this plug apart, since there are no bushing, gaskets, or threaded parts.

The spark-gap is inclosed in an air-tight chamber which soon becomes a vacuum as the spark consumes the oxygen and nitrogen.



"No more broken porcelains," says the maker of this spark-plug, which embodies a new principle

Shipping Trucks in Cases Half Their Size

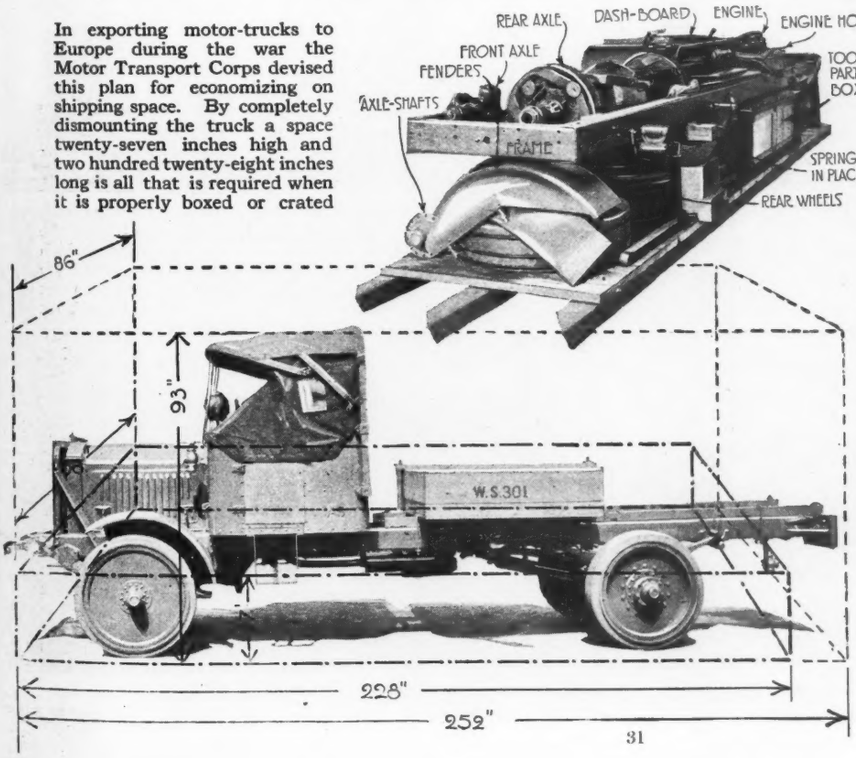
SHIPPING motor-trucks overseas in cases whose volume was little more than half those of the trucks when put together, was a task accomplished by our Motor Transport Corps.

When these vehicles were first sent overseas they were crated in much the same manner as a piano. With the wheels in place and the top folded down, they took up a volume of 1,166 cubic feet.

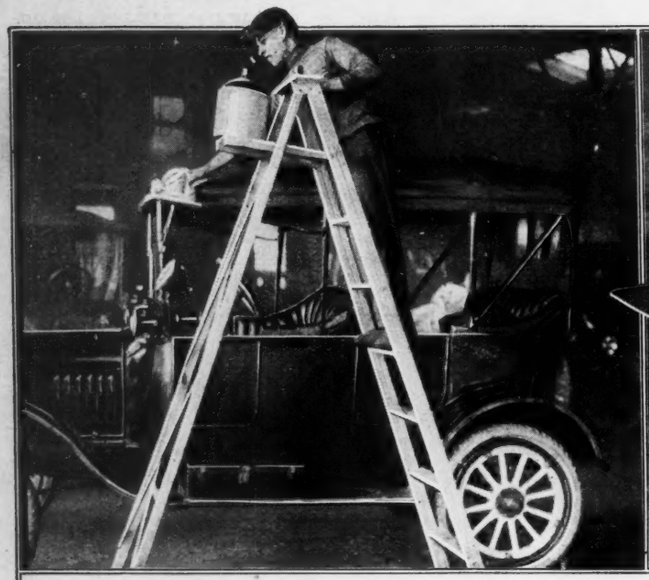
Then shipping bottoms became scarce at exactly the same time that the need for trucks became greatest. The Government told the truck-makers that the volume must be reduced. They, in turn, suggested that the truck be entirely knocked down, with wheels, axles, and even the motor taken off and blocked up on the base of the crate as shown in the illustration. This done, the space was reduced to 302 cubic feet. The comparative volumes assembled and knocked down are shown by dotted lines.

If any truck exporter had suggested before the war that such a saving could be made, he would have been laughed at. The saving effected thus points the way to economies possible for the commercial exporter of tomorrow.

In exporting motor-trucks to Europe during the war the Motor Transport Corps devised this plan for economizing on shipping space. By completely dismounting the truck a space twenty-seven inches high and two hundred twenty-eight inches long is all that is required when it is properly boxed or crated



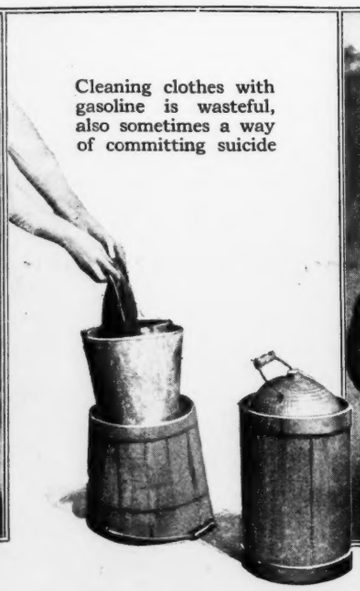
A Fool and His Gasoline Are Soon Parted



Want to ruin your top? Then clean it with gasoline, which destroys the rubberized fabric. Use clean water and castile soap to keep it in good condition

Remember how the garage man pulls out the filler hose still dripping from your tank? That's what is left of the gallon you're supposed to get and are paying for

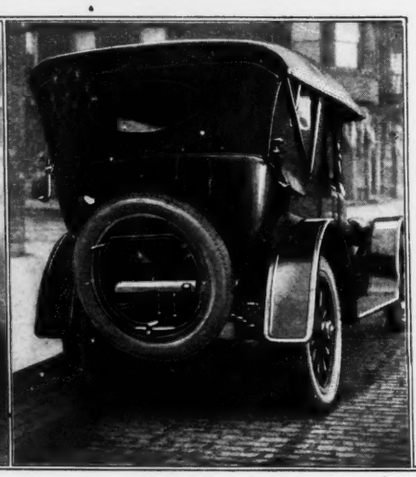
Here's why gasoline bills soar upward. Pumps are guaranteed not to drip, but some of them do, even to the extent of a gallon or more a day



Cleaning clothes with gasoline is wasteful, also sometimes a way of committing suicide

Use a drip-pan when you are drawing gasoline from the pump, and pour the overflow, which would otherwise be wasted, back into the tank

Tighten all the gasoline line connections every so often. That seemingly small puddle under your car costs you real money



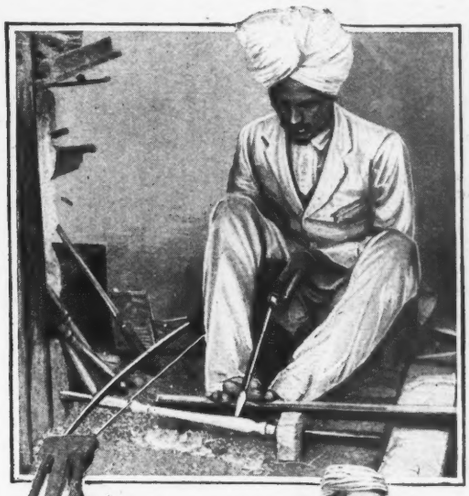
Never allow the engine to idle when the car is standing. Shut it off and use the self-starter. It pays to take this slight precaution

They're Handy with Their Feet

And so they find it easy to earn a living with their toes

He never had any arms, so his toes have always been his fingers. Just now they are holding up a letter for him to read; but they are also good at writing, eating, painting, and swimming

The Hindu toes the mark made by a cutting tool on wood; a lathe turns the wood and his toes hold the tool



He lost his arms in the army—the German one—and now he fiddles with his feet. Perhaps he can tell us more about that mysterious popular song and dance called "That Tickle Toe"

There wasn't much left of him when the war got through with him, but at least it left him two good feet to paint with

Getting his wrists tattooed to keep away the snakes; this tattooer uses his feet to hold down his victim's arm

The weaver of Formosa raises the alternate ranks of warp threads with her feet and works the shuttle with her hands

Tamping the turf of Holland with all fours. The tampers stamp with their turf-shoes and pound the ground with mallets

A Home-Made Gasoline Buzz-Saw

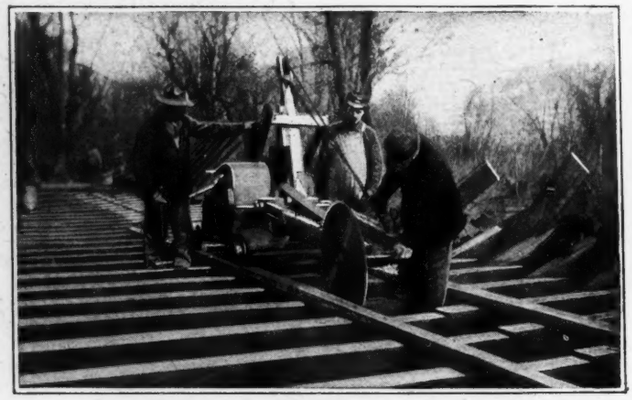
How it was used to break up a bridge

AN Iowa lumber concern purchased one of two large pontoons that had served for fifteen years as the support of a railroad bridge between North McGregor, Ia., and Prairie du Chien, Wis.

When the bridge had been towed down the Mississippi to the yards, the lumber company was confronted with a difficult problem.

The pontoon was 408 feet long and 40 feet wide, and contained valuable timber.

The stringers that held the bottom were spaced two feet apart, and it was impossible to use one of the big two-men cross-cut saws. A hand-saw might have been used, but that would have made the work extremely slow besides being very costly.



It traveled from stringer to stringer, cutting them as it went

The problem was solved by rigging up a circular saw driven by a small gasoline engine on a framework on wheels.

A track of two-by-four planks was laid across the stringers, and the frame, after the saw had been mounted on it, was run along this track. The saw disk was mounted at the end of a hinged arm, which could be lowered as the saw cut through each stringer.

Three men were required to operate the device—one to attend to the engine, another to manipulate the levers of the mechanism, and the third to guide the saw.

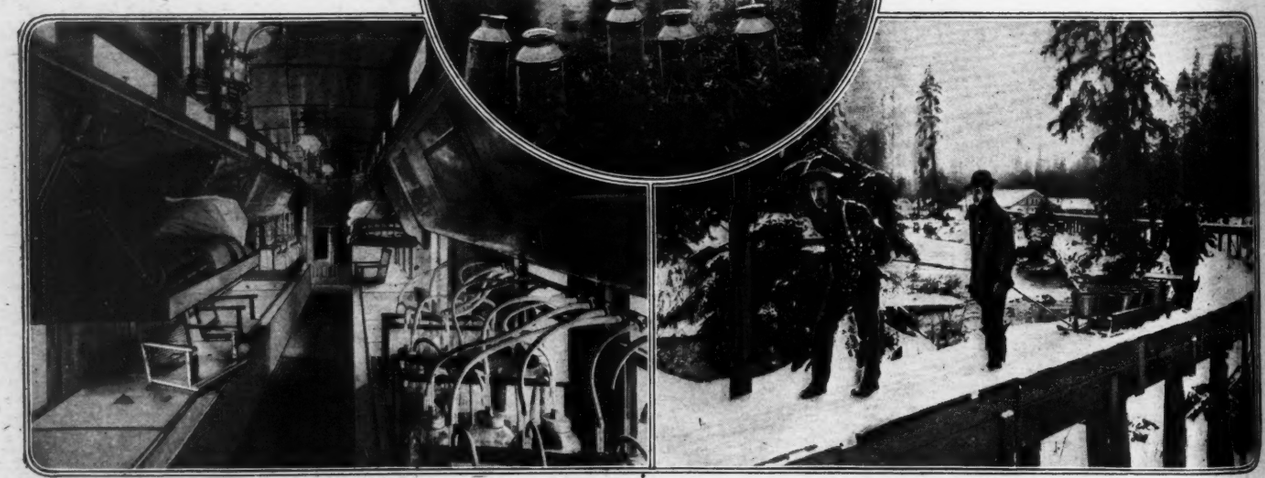
More Fish-Eaters Wanted

So the Fish Commission transplants fish to fishless waters

MANY rivers, lakes, and ponds throughout the United States that would make excellent homes for fish are uninhabited because fish, like people, pick out one small section for homing, and crowd into it, ignoring other places equally suitable. The result has been that when transportation facilities were in bad shape, people in districts whose rivers could boast of no fish would get none to eat, while other districts would be oversupplied.

The government decided to step in and even things up, and so the United States Fish Commission began to transplant fish. But they soon found that this was no easy matter, for if the fish were handled roughly they would not survive the trip. One of the results was a specially constructed car. All the lower-berth space is turned into an aquarium for the fish. The government men who travel with them must be content with upper berths to sleep in and legless wicker chairs to sit in.

Very young fish thrive in new surroundings better than do their old settled parents, and so the government either catches them young and transplants them, or gathers eggs, hatches them, and gives the resulting fish their start in life where the Fish Commission sees fit. The young fish are carried from train or hatchery in pails. The temperature of the water in the cans is either raised or lowered gradually until it equals that of the river or lake in which they are to be placed. Then the fish are gently eased into the water.



In this special car for traveling fish the lower berths have been turned into aquariums

Gently tumbling the fish into a stream that is to be their new home

Cans of young fish on their way from the hatchery to the river shown above

Shooting Pictures from an Airplane

If the airman had been shooting bullets from his machine-gun instead of pictures, there is no doubt that he would have hit the airplane

KNOW what the enemy is doing! That maxim of warfare demanded superior airplanes and cameras—airplanes for seeing and cameras for recording the things seen. Forthwith the airplanes were improved on, and so were the cameras, until now the United States has a camera that will take moving pictures of the ground below from a height of three miles, bringing out the smallest details—even foot-prints on the ground. As the sharp lens of the camera looks through the bottom of the airplane's fuselage, it sees things that the airman himself cannot detect.

The lens represents the work of the Kodak Laboratory and is far superior to Germany's best. It has a focal length of fifty inches and a diameter of ten inches. The camera itself is of enormous size, and has two striking new features—a pan-chromatic plate which records many different color values, and a ray filter which enables the lens to penetrate even through clouds. Since the end of the war these cameras have been used for surveying.

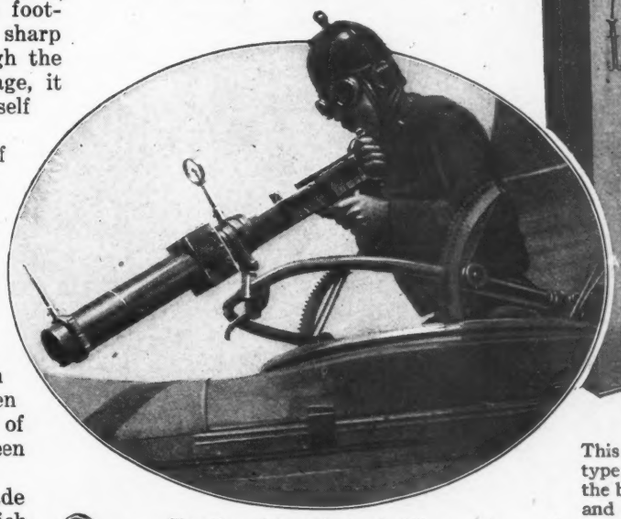
In one instance a map was made in two and one half hours which would have taken a hundred surveyors five years to finish.

Air fighting came as an attempt to prevent enemy observers from taking these secret-revealing pictures.

It was very hard to train the fighters on land to aim accurately at the enemy airplanes which they would meet when flying at many angles. This difficulty was overcome by another American camera invention.

The gun-camera used by the British was a separate unit on the British airplane. The Americans changed this gun so that it would fit the regular Lewis machine-gun and shoot one hundred pictures at a loading. Thus, by shooting pictures at each other just as they would shoot bullets at the enemy, they learned to correct their aim.

In peace times the gun-camera will prove valuable in improving airplane tactics. Every flying-field of the American army and navy is now equipped with the device.



Shooting pictures instead of the customary bullets from a Lewis machine-gun

This is the most highly improved type of camera. It looks through the bottom of an airplane's fuselage and takes pictures at a height of three miles. The young man is removing the plates after a flight

If the lamp-bulb is broken, the current is instantly shut off, preventing danger from explosive gases

The Light that Never Failed

THE child who said, "Don't go down the mine, daddy," several years ago knew what she was talking about, for the mines then were far more dangerous than they are today. Even the miner's lamp has been so improved that it simply can't get into trouble down in the most gaseous mine. Take, for instance, the lamp shown in the hat of the miner in the picture to the left.

Except for its glass front and the cord from battery to lamp, the entire apparatus is inclosed in a non-conducting, non-corrosive material which has the tensile strength of aluminum. This keeps it from short-circuiting in the vicinity of electric machinery and from deteriorating in acid vapors. The cord fits into a funnel-shaped groove in the battery-case when it is not in use.

Even if the glass bulb should break, thus exposing the white-hot wires, the customary explosion would not occur. The secret of the bulb is this: when the glass breaks the current is automatically disconnected. There are two bulbs in each lamp, so that if one fails the other will shine on.

The lamp is attached to the miner's cap and the battery is strapped around his waist, leaving his hands free.

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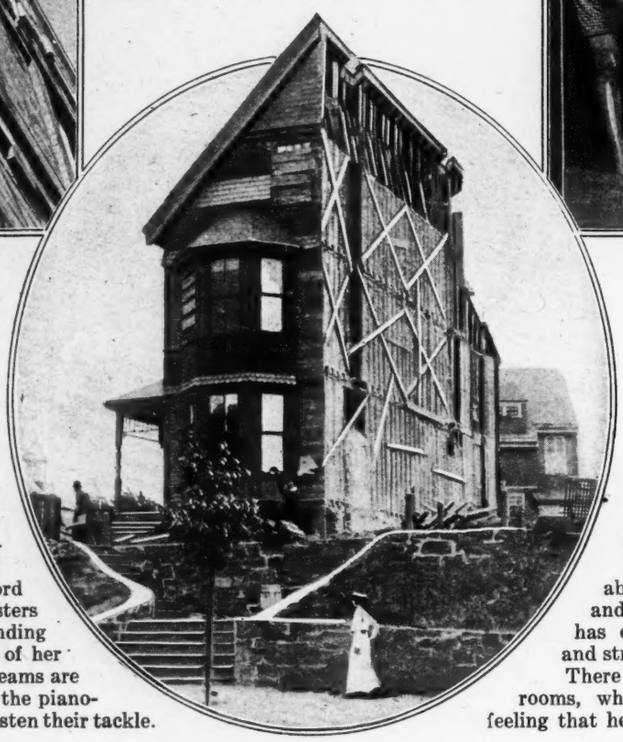
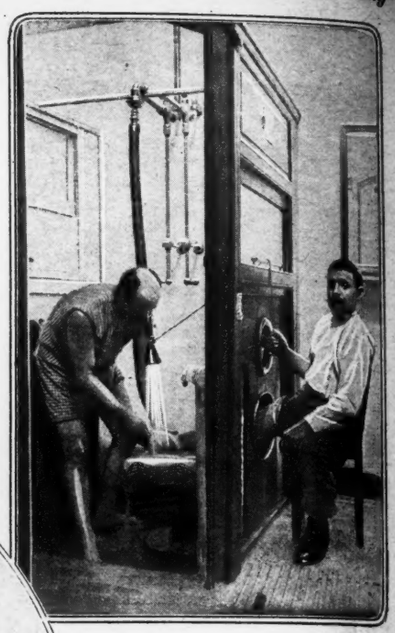
The House that Was Moved in Sections

IN West Somerville, Mass., a large three-story dwelling was cut in two, moved from its site ten feet above the street-level, and set up a mile distant from its former resting-place.

After bracing the house, first one section and then the other was moved to the new location with jackscrews and rollers. On bringing the two portions together they dovetailed into such a perfect fit that it was impossible to discern the separating cut. The structure was prevented from toppling over by tearing down the chimneys and loading the first floor with bricks.





Woman's Foresight Aids the Piano-Hoister

WHERE to anchor the ropes that hold the tackle of the piano-hoisters is always a problem in apartment-house moving. Usually a stout-looking chimney or confidence-inspiring cornice is relied upon, but occasionally the chimney or cornice defaults on its part of the contract while the piano is in midair.

It remained for a woman landlord to foresee the task of the piano-hoisters and to provide steel beams extending out from just below the cornices of her apartment-houses. These steel beams are provided with stout eyes to which the piano-hoisters can safely and securely fasten their tackle.

A Private Room for Treating Injured Legs

A DOCTOR in France who specializes in leg and foot troubles has a leg room. The patient, sitting in one room, puts his leg through a hole in the wall and it emerges in the next room. Thus the doctor deals with a leg and not a patient, and is able to do his work without interruption.

In the particular instance shown above he is administering a foot-bath, and in order to do it thoroughly he has donned a bathing-suit of checks and stripes.

There is an open window between the rooms, which saves the patient from the feeling that he has lost his leg entirely.

The Hand-Ball Court of Courts

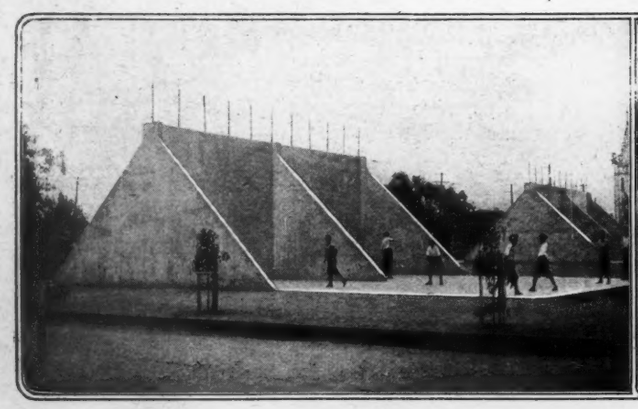
THE care and thought spent on educating and entertaining the children of today should make the next generation quite perfect. When, in our youth, we wished to play hand-ball, we used as a wall a bill-board or the back of somebody's house—until the owner chased us away. But modern boys need only express a desire for hand-ball, and lo! excellent concrete courts are promptly built.

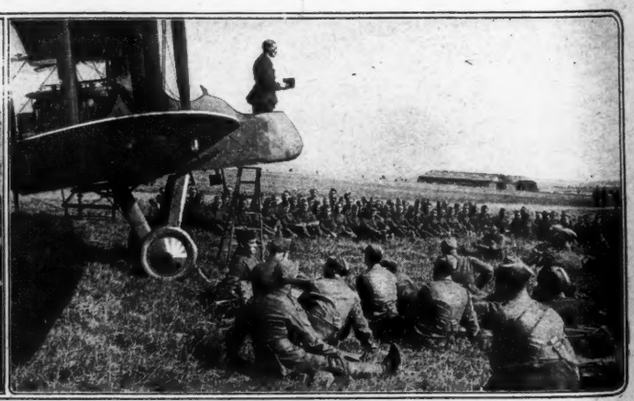
The boys in the picture below are students of Loyola College, in Los Angeles, and the courts are on the college grounds. The wall is about twenty feet high and six inches thick. The partitions and flooring are also of concrete.

His Pulpit Is an Airplane

"SKY-PILOT" may mean either an aviator or a clergyman, depending entirely on whether you are speaking scientifically or slangily. The sky-pilot shown below would seem at first glance to be a scientific one, since he is standing in an airplane; but he is really the slangy kind. It is Sunday morning in France, and he is preaching to the assembled airmen. He is using the observer's seat for his pulpit, and it makes a very good one. This airplane hurled bombs down at Germans only a short time ago.

When the service was announced, some of the boys brought out drums and cornets and practised up on hymns, which they played before and after the sermon with great fervor.





A Stout Small Bag for Mailing Cuts

TO pull a string and tie a bow-knot is a very simple task, quickly executed. Realizing this, an economizing electrotyper in business in New York decided to mail his cuts in bags instead of wrapping them up in box, paper, and cord, and thereby saved considerable time, labor, and money.

A flap is attached to the bottom of each bag and on it are placed the address and stamps.

The cut is wrapped in corrugated board and placed in the bag, the string is pulled, and the bow is tied.

Of course there is some danger that *en route* a postman may accidentally pull the string and let the cut out of the bag.

© International Film Service

His Life Saved by a Bell

COYOTES do not like bells, but they do like turkeys. In fact, if a Western turkey strolls a short way from home, some coyote is sure to pop out and eat him.

The chances are that the turkey, since he must be eaten, doesn't care who eats him; but the turkey's owner cares. He can't send butcher bills to coyotes. So most Western turkeys wear bells around their necks, as per order of their owners, and the coyotes are frightened off.

It is not so many years since people would run at the sound of a bell in the woods. In some countries lepers were made to wear them on their unhappy wanderings as a warning to other people not to come too near.

To Keep the "Venetia's" Gold Star Shining

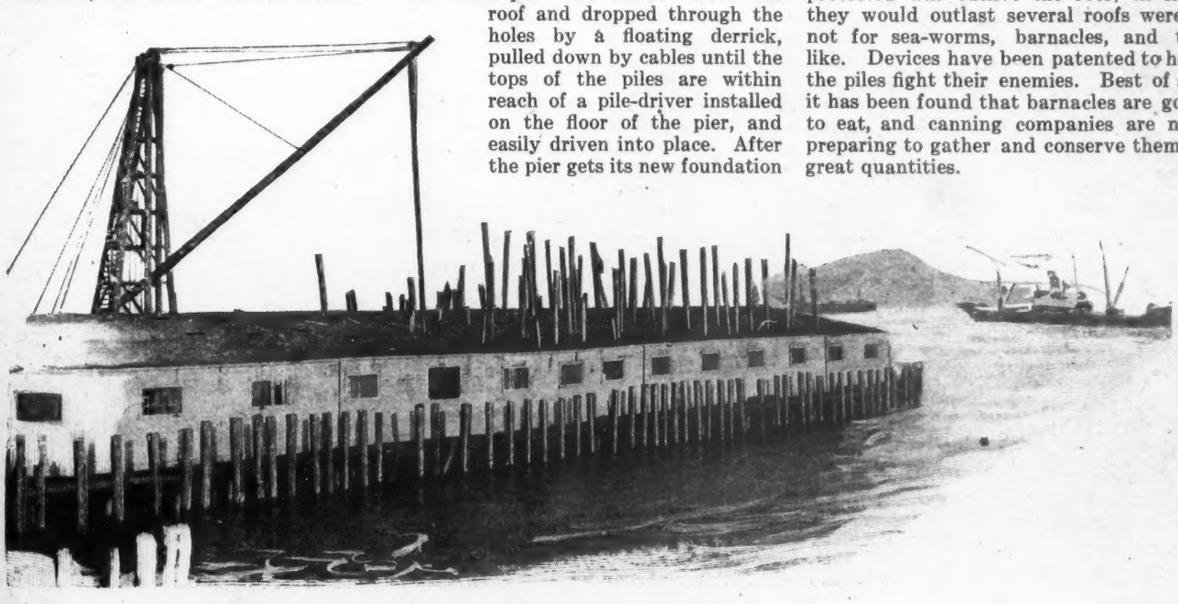
THE *Venetia* really deserved a Distinguished Service Cross. She served in the Great War, and distinguished herself by crippling the U-39, which had to limp to Cartagena, Spain, and be promptly interned. But a one-inch medal on an ocean-going liner wouldn't show up very well, so the *Venetia* was awarded a large gold star, which was hung in a conspicuous place on her funnel.

When the gold grows dull, the sailors climb up and polish it. That sounds simple enough, but look at the picture.

Mending Old Pier-Sheds—But It's Hard on the Roof

WHEN the piles supporting pier-sheds in San Francisco succumb to years and barnacles, the State Harbor Board orders holes cut in the shed roofs,—a hole for every ailing pile,—and gets to work.

The new piles are raised above the roof and dropped through the holes by a floating derrick, pulled down by cables until the tops of the piles are within reach of a pile-driver installed on the floor of the pier, and easily driven into place. After the pier gets its new foundation of piles it also gets a new roof or a nicely patched one. As a rule, good piles properly protected will outlive the roof; in fact, they would outlast several roofs were it not for sea-worms, barnacles, and the like. Devices have been patented to help the piles fight their enemies. Best of all, it has been found that barnacles are good to eat, and canning companies are now preparing to gather and conserve them in great quantities.



The Same Old Job

With power-driven brushes and vacuum cleaners women do their house-cleaning now on railroad cars

Removable parts of doors, frames, and moldings are taken down and given a thorough cleansing

An energetic woman cleaning the wood-work in the confined space of the corridor of a car

YOU know what spring house-cleaning meant before the days of vacuum cleaners; but do you realize what it means to give a thorough cleaning to a whole train of railway cars? It means all the dust and dirt, all the hard work and discomfort of house-cleaning raised to the *n*th power. Where men and women for doing that kind of work are available, the railway companies continue to adhere to the old hand method of cleaning their coaches; but the difficulty of obtaining cleaners is steadily increasing.

Labor-Saving Car-Cleaners

This scarcity of workers has led many railroad companies to the employment of labor-saving machinery with which one man or woman can accomplish as much in an hour as three or more cleaners used to accomplish in the same time. The use of such labor-saving machinery and mechanical appliances has proved a remarkable success economically and highly satisfactory as a hygienic measure. The appliances are of small weight and may be used by persons of average physical strength for many hours at a time without undue fatigue. They are so simple of construction that the cleaners using them need not be specially trained in the proper use of the machinery and auxiliary appliances.

For cleaning the woodwork, rotary brushes and buffing-wheels, driven by compressed air or electric motors, are used. The brushes, which are in the form of disks or cylinders, are mounted on flexible shafts connected with the engine that furnishes the power. These brushes make from five hundred to eight hundred revolutions a minute. They weigh only a few pounds, so that they can be operated without excessive effort by any woman of average strength.

If the cleaning is done in the car-shop, the rotary brush is suspended by a wire from a trolley running alongside the car-track. To facilitate the raising and lowering of the brush while working on the outside of coaches, the suspension wire runs over a pulley and has a counter-weight at the other end.

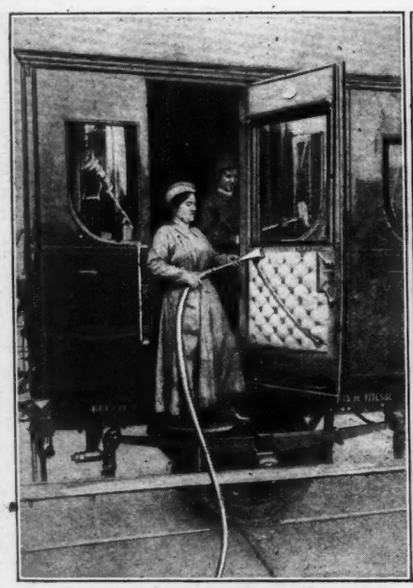
When the brushing and cleaning is to be done on the inside of a coach, the driving mechanism of the brush is mounted on a stand resting on casters, or is suspended from a bar temporarily placed across the compartment of the coach from one luggage-rack to another. Disk-shaped brushes are used where it is necessary to clean cracks, corners, and other confined spaces, while cylindrical brushes are used for cleaning large flat surfaces.

The Railway Cleaning Shop

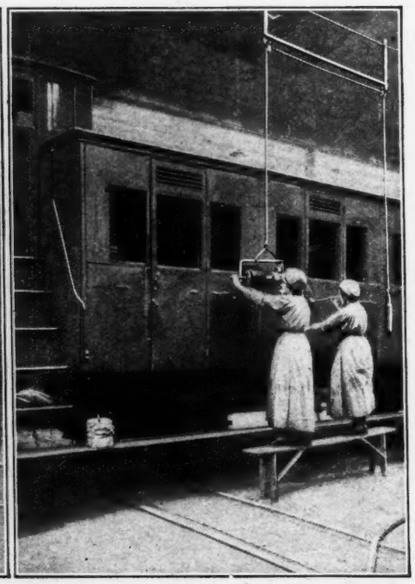
The window-frames and other removable parts of the coaches are taken to a shop especially provided for that purpose, where they are placed on tables in a horizontal position and brushed and cleansed with rotary brushes and buffing-wheels. The repainting and re-varnishing is done at the same shop.

The cloth of the upholstered seats and back-rests and on the lower part of the doors of the coaches is cleaned by means of a vacuum cleaner. After the dust has been removed, the cloth is sponged with a cleaning fluid and then thoroughly brushed. Next the cloth is washed with water, and then the vacuum cleaner is again used to remove the excess water from the upholstery. How thoroughly this is done by the vacuum method may be inferred from the fact that the complete drying of cloth-covered cushions requires only a day or two. When necessary, disinfectants may be applied to the upholstery during the cleaning process.

Each coach is brushed inside as well as out every day, but only once every fortnight is it given a thorough scrubbing and cleansing. At the same time, necessary repairs are made and missing parts replaced.

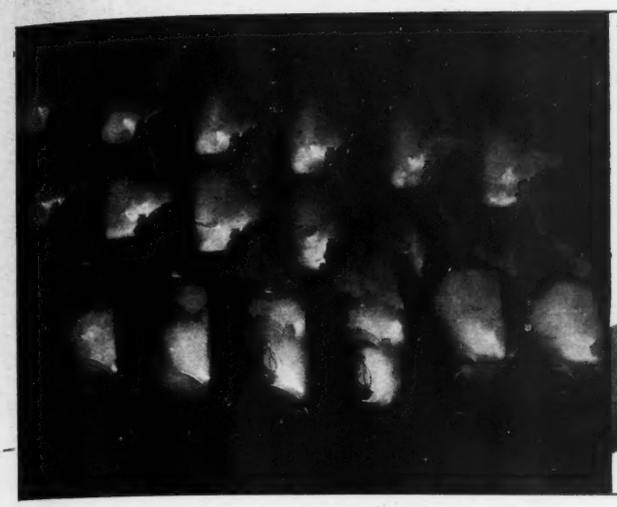


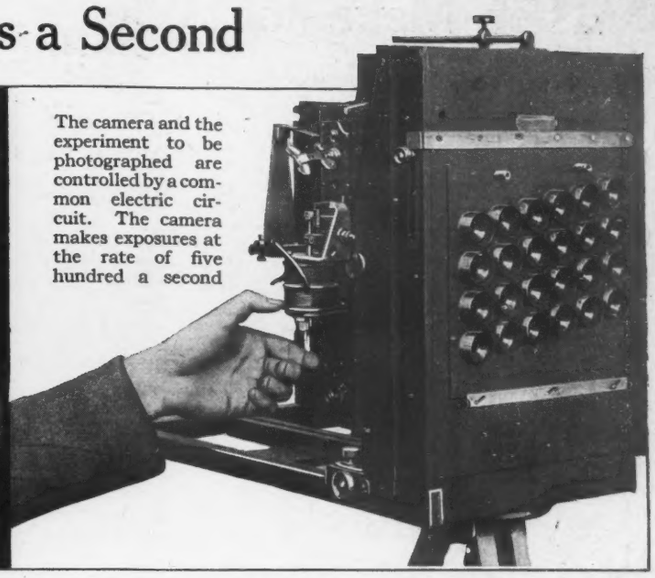
Upholstery is freed from dust and dirt by a vacuum cleaner and a rotary electric brush



Women removing the dust and soot from the outside of a coach with an electric brush

Five Hundred Pictures a Second





The camera and the experiment to be photographed are controlled by a common electric circuit. The camera makes exposures at the rate of five hundred a second

SUPPOSE you wished to know what an arc caused by a broken circuit looked like. An ordinary camera might photograph for you one small phase of the arc, but the camera shown here will give you all the details from beginning to end.

You put your camera in the circuit with your arc, then close the switch and start them off. The camera will take five hundred pictures in a second.

It is made up of twenty-four lenses, one front board for holding the lenses, twenty-four tubes for shielding them, one focal plane shutter, and one camera-box. Each lens is set in a separate tube fixed to the front board, which allows of individual focusing. Each lens also has another tube inside, to prevent interference between light rays from adjacent lenses.

The focal plane shutter measures eight by ten inches. It is a long curtain with many horizontal slits in it, and is mounted on rollers. The curtain is moved until any one of its slits lies between the lens tubes and the photographic plate. The time of exposure may be adjusted from 1-1500 of a second to 1-10 of a second. The curtain is then operated so that it uncovers each lens successively.

The shutter is opened and closed by a trigger worked by electricity. The object or experiment, or the position where this will be when the electricity is started, is first focused on the ground-glass. Then each lens is adjusted to give a sharp image. Next the shutter is electrically connected with the circuit which starts the experiment. The first lens is uncovered just before the spark starts. When the shutter is adjusted, the plate is inserted and the spark and camera started.

Let Your Camera See Red

FOR several years the Bureau of Standards has been staining photographic plates for spectrum investigations. Ordinary commercial plates, which are sensitive only to waves shorter than those of green light, were stained in the Bureau's laboratories with certain dyes that made the plates sensitive to yellow, red, and infra-red light.

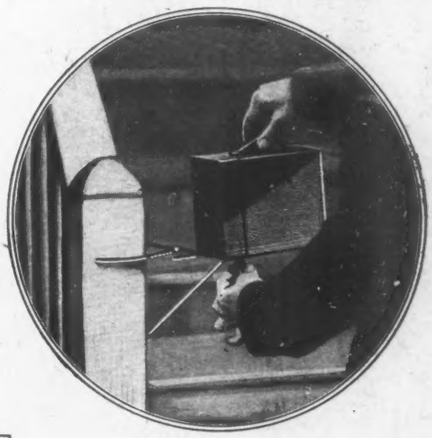
When the United States entered the war, it was recognized that these stained plates might be valuable in military work by making it possible to obtain photographs with short exposures through yellow and red colored screens.

Some of the advantages derived from the use of the red sensitive photographic plates are the reduction of haze and other atmospheric effects which are particularly injurious to photographs taken from the air, and increase in the contrast to show more detail and detect camouflage.

Experiments conducted by the Bureau of Standards have led to remarkable improvements in the manufacture of panchromatic plates.

A photograph taken with an ordinary photographic plate on a hazy day

The same view obtained at the same time with a red sensitive plate

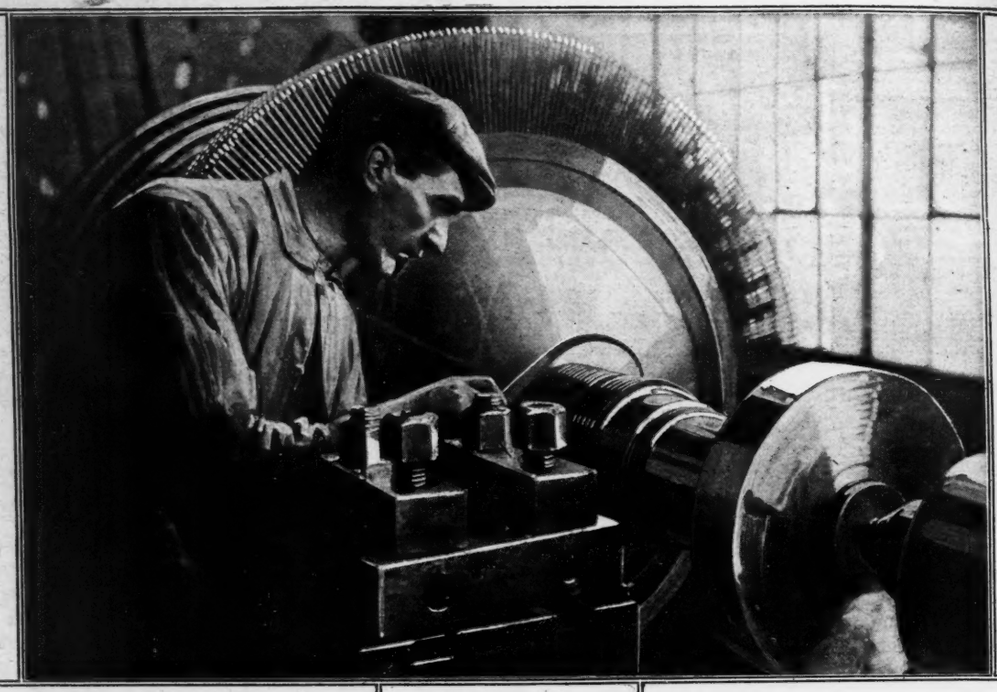


A Substitute for the Camera Tripod

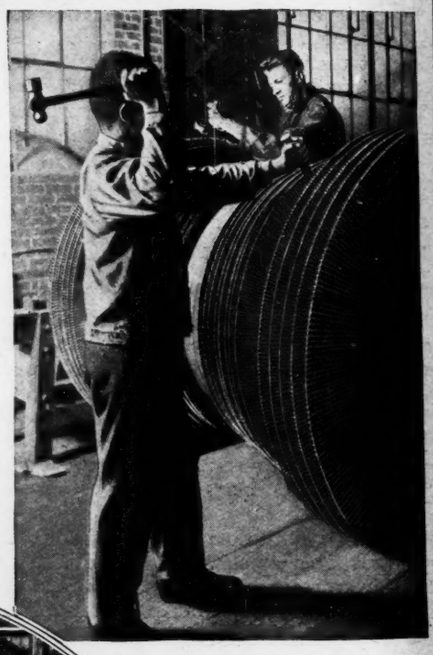
YOU can fit this new camera support in your coat pocket. It is made of a pair of metal tongs, one leg of which is joined to a long metal bar which is sharply pointed at its other end.

When you wish to take a picture, fasten the tongs into the nearest tree, fence, pole, or house. Then thrust the pointed end of the bar into the wood farther down so that the tongs will be on a level plane. The camera rests on the extended level arm.

They Make the Wheels Go Round in a Turbine

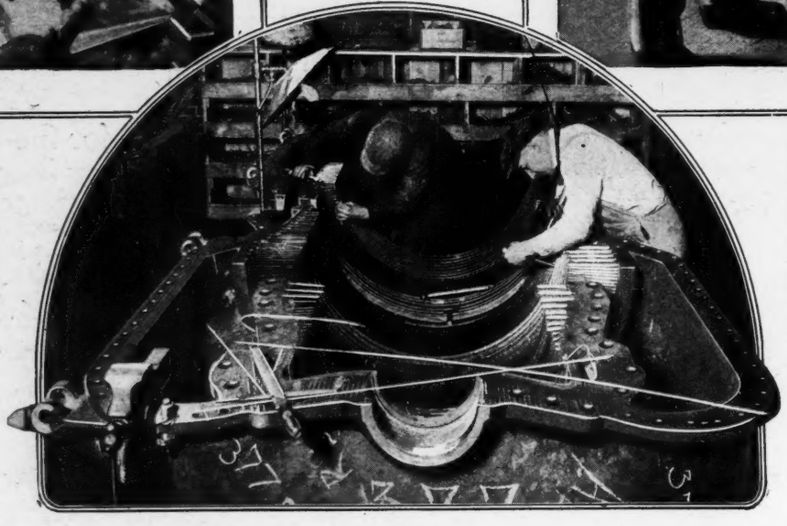


No other type of steam engine demands such careful workmanship and exactness as the turbine. The thousands of vanes must be absolutely true. Should one come loose it would wreck the whole machine



Superheated steam is forced into the casing, and, directed by the slanting projections of the casing against the vanes of the shaft, causes it to rotate with prodigious speed

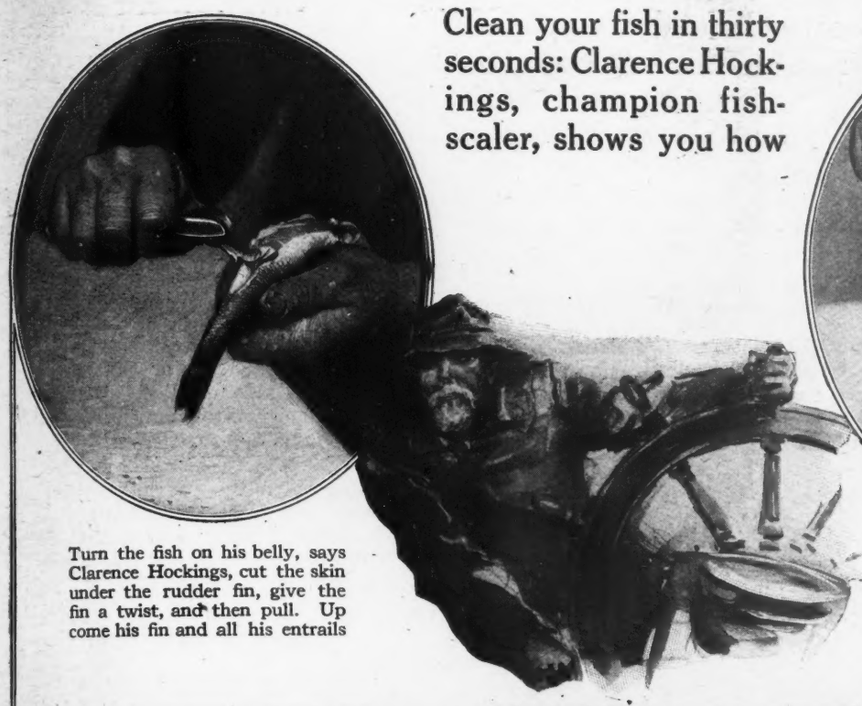
The vanes are welded to the shaft, and form rings that fit between similar rings of vanes that project inward from the stationary casing which surrounds the part of the turbine that turns



After the thousands of individual vanes have been welded to the shaft they must be carefully straightened and adjusted to make sure that they fit between the rings of the casing

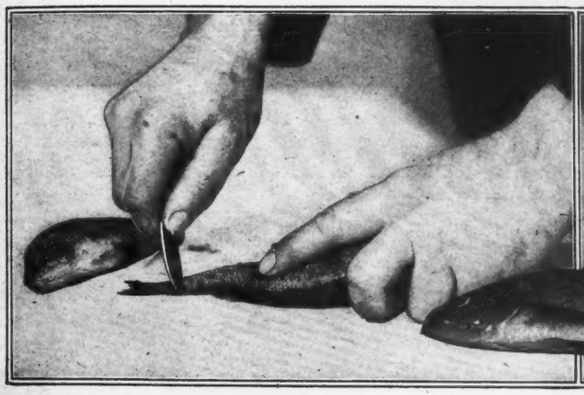
Out of the Water into the Frying-Pan

Clean your fish in thirty seconds: Clarence Hockings, champion fish-scaler, shows you how



Turn the fish on his belly, says Clarence Hockings, cut the skin under the rudder fin, give the fin a twist, and then pull. Up come his fin and all his entrails

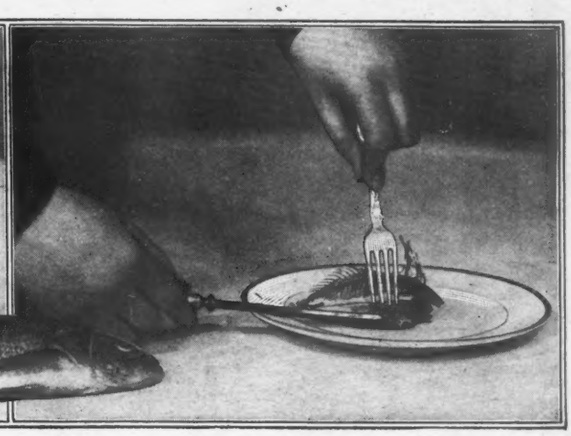
Then turn him on his back, slit the skin behind his dorsal fin, grab hold of it, and pull. Out come the many unattached small bones that stick in your throat



But, before you start to tear him up, scale him with your knife. Hold the knife just as you would your razor

Snap off his tail as if he were a string-bean—by a quick jerk of your knife; never try to cut bones

Off with his head! Don't chop it off; just cut the skin around it and twist it off with your hands. The entrails, loosened above, will follow



Don't bite him till you bone him. Slip your knife under his well cooked ribs and spine and lift them; the tender flesh will fall away

In the Grip of the Deep

How wonderful diving suits enable men to face terrific under-water pressure

By Waldemar Kaempffert

FULLY eight thousand ships lie at the bottom of the ocean—ships of all countries, which were torpedoed, mined, bombed, scuttled, or sunk by the shell-fire of German submarines. The world needs shipping, despite the wonderful efforts that were put forth in the United States and in Great Britain to keep pace with the sinkings of German submarines.

Let us admit at the outset that most of the ships that were sent to the bottom cannot be recovered by the methods that have thus far been developed. In the open sea it is hardly practicable to recover a ship that lies at a depth greater than one hundred feet. Only in a sheltered bay are greater depths reached.

How are they reached? By actually sending a man down beneath the waves—a man who dons a diver's dress and adapts himself to conditions that nature never intended him to meet.

A Remarkable Invention

In many ways the diver's dress is one of the most remarkable of inventions. Reduced to its essentials, the dress consists of an incompressible metal helmet and a compressible fabric garment for the body and legs.

Air is pumped into the helmet, and thence into the upper part of the dress, through an air-hose connected either with a pump or a tank of compressed air in a surface vessel. It escapes through an automatic valve in the helmet which the diver can regulate.

Blown up with air, the dress containing the diver becomes a veritable bubble. To sink it and keep the man inside in an upright position, it must be weighted. Hence shoes are donned, each of which contains sixteen pounds of lead. Around the body eighty pounds of lead are distributed. Exclusive of the diver, the dress weighs one hundred and seventy - five pounds. In order to prevent the diver from capsizing and coming up feet first, even though he may be thus weighted, the legs of the dress are laced up the back, a procedure recommended by the British Admiralty and adopted by the United States Navy.

Everything depends on the nice regulation of air-pressure. If the pressure is too little the diver feels the water trying to squeeze him; if it is too great his dress becomes too buoyant. So he adjusts the valve in his helmet until the water-pressure without is a little more than equalized by the air-pressure within.

The automatic escape-valve also provides an outlet for the poisonous carbon dioxide exhaled. Bubbles of air constantly stream out of the valve. Since it is automatic, the valve is forced open to let the surface air escape when the pressure within becomes too great. Moreover, it is so constructed that water cannot enter. The diver must adjust the valve to suit his convenience.

How He Goes Down

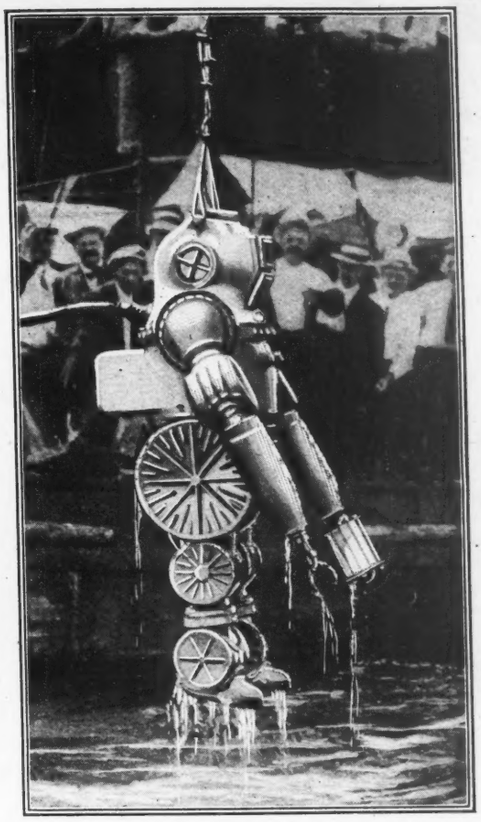
The diver descends by a "shot-rope"—a rope sunk by a heavy weight or a shot. When he reaches

Study these rear and front views of the Schrader regulation navy diving-dress, and you will understand what it means to stay under water at a great depth. The shoes are weighted with sixteen pounds of lead each. About eighty pounds of lead are carried on the body. Exclusive of the diver, the dress weighs 175 pounds. Air is pumped in through the helmet. By means of a valve the outer pressure of the water must be counteracted by the pressure of the air. The legs of the suit are laced up the back, a procedure recommended by the British Admiralty, in order to prevent the diver from capsizing and coming up feet first. Everything depends on the nice regulation of air-pressure. If the pressure is too little the diver feels the water trying to squeeze him; if it is too great his dress becomes too buoyant. The deeper the diver descends, the shorter is the time that he can stay below. The record by the United States Navy is about 300 feet

the bottom he takes with him a "distance-line" attached to this weight. The distance-line helps him to find the shot-rope again; for it is dark far below the surface—darker than the darkest night. He must feel his way. A little electric lamp held in the hand illuminates an object a few inches away. That is all the light that he has.

He reaches the bottom. One pull on the breast-rope tells the attendant above. The diver clears away the distance-line, coiling it in the left hand, and slips the left wrist through a loop at the end, so that he will not drop the line in a moment of forgetfulness. The bottom is often muddy. Therefore he does not flounder about and stir up the silt; he knows that a cloud of mud would prevent him from seeing anything.

For the same reason, the diver keeps to the lee side of his work if there is any current. He spreads himself over the bottom, particularly if it is soft. He does not try to stand. He crouches close to the ground, so as to offer as little surface as possible to the action of the tide.



Why not make a diving armor inherently so strong that it will resist the squeeze of the water at great depths? Here you have the answer in an elephantine contrivance with which some promising experiments have been made. Since the man inside has very little freedom of movement, he must be hoisted overboard by a derrick. The armor has an artificial arm or claw. If a man were to stick out his hand at the great depth to which this suit can descend, it would be crushed into a pulp by the mere force of water-pressure

Safer than It Used to Be

Thanks to the researches conducted by the British Admiralty, diving is a safer profession than it used to be. A man no longer risks his life when he has descended to the great depth of three hundred feet. Time was when a diver was hoisted to the surface after having performed his work below, sometimes at a depth of more than one hundred feet, without any regard to the interval that should be allowed.

When a man is subjected to great air-pressure, his blood and his tissues absorb nitrogen. This nitrogen is not chemically combined with the blood, as in the case of the oxygen that we breathe, but is released again in the form of bubbles when normal pressure is restored. In other words, a man who works in a diver's suit at a depth of one hundred or two hundred feet is like a siphon of seltzer water. So long as he remains at that depth or is subjected to the equivalent air-pressure, his blood is as quiet as the water in the siphon. But if the pressure be suddenly removed the nitrogen bubbles off from his blood exactly as a gas bubbles up out of the water in the siphon when the spring valve handle is pressed down and a glass of water is drawn. This bubbling up of the nitrogen is extremely painful. What is more, it may cost a man his life. He suffers from what is known as "caisson disease" or the "bends."

Getting into the diving armor is a feat that a circus contortionist might be able to perform with celerity. Yet something like the invention pictured below will have to be used if depths greater than 300 feet are to be reached

Working Under Water

The British Admiralty's investigating committee, consisting of Dr. Haldane, Dr. Boycott, and Lieutenant Damant, discovered that if a diver is brought up gradually from a great depth nitrogen is able to boil from the blood and tissues so slowly that no distress is experienced. A table was compiled which is now consulted whenever it is necessary to send men to the bottom of the ocean. That table tells at once at what rate a man should be hauled up.

The deeper a man goes, the less work is he able to perform. When the United States Navy divers descended to a depth of three hundred feet, for instance, they could do little more than walk about for a few minutes in order to locate the wreck of the F-4. Now, a diver is supposed to work under water. Usually he locates a wreck and patches up the leaks. Since his efficiency is limited by his depth, it is clear that the present form of diver's dress is not all that can be desired.

Why is it not possible to construct a suit of steel—something so strong that it will of itself resist the pressure of water at even six hundred feet? The diver could then breathe air at ordinary pressure. Inventors have contrived new suits—diving armor—that are amazingly ingenious. And yet ship salvors and men who work at the bottom of the ocean will have none of them.

The diver cannot directly use his hands when he is incased in his suit of armor. Indeed, it would be squeezed into a shapeless mass if he could protrude it at a depth of several hundred feet. Hence, ingenious artificial hands have been invented which are worked from the inside of the suit. Sometimes these artificial hands are mere claws, sometimes highly ingenious and complicated mechanisms.

Perhaps some form of diving armor will be invented to meet the salvage engineer's requirements. Certainly the rewards to be earned are rich; for literally billions of dollars' worth of ships and cargos lie at the bottom of the ocean.

When the fish smell the concoction with which this boy is anointing his hook, they will follow their noses to their fate

How to Make the Fish Bite

"FISHIE, fishie, come bite my hook; you'll be captain, I'll be cook." So sang the small boy of a not remote yesterday—also he sometimes spat upon the hook "for luck."

But to-day's fisherman, boy or man, trusts less to luck and more to science. He has the latest inventions of the rod- and tackle-makers—strange "plugs" and spoons and other glittering or queer moving things to catch the attention of his victims.

Not content with dangling or flashing fascinating lures before the fishes' eyes, he now adds the attraction of the sweetest perfumes—sweetest, at least, to a fish's nose—and the boy in our picture may be seen anointing his hook with such a liquid bait.

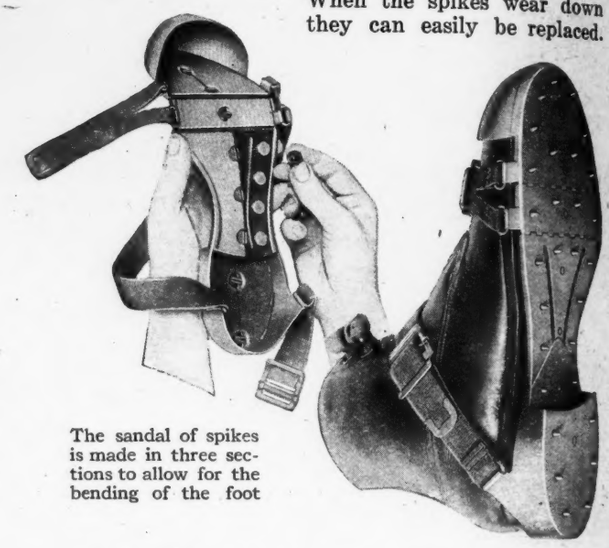
The author of this ingenious idea, George W. Julian, of Boston, Mass., says it will make fish swim right into the boat.

All that remains now is to invent a musical attachment for hooks that will call the fish by sweet strains to the dining-place.

Hob-Nailed Sandals the Latest Necessity for Hikers

WHETHER to wear hob-nailed boots or not to wear them—that is the question when you go for a tramp. You want them when you walk over soft, muddy fields, but you don't want them when you return to pavement. Here is the solution: wear the nails in a detachable sandal.

The kind shown below was invented by Charles Roe of Indianapolis. The sole is made in three sections to allow for bending. The heel is attached to the sole, and both are made of metal. The spikes are made separately, and are put through holes in the sole. They are kept in place by metal insoles, one for each section. The insole for the smallest section is made in one piece and is easily sprung into place. The other three are divided in halves and slid into place. They are all held fast by several set-screws. A metal tip and two straps make up the rest of the sandal. When the spikes wear down they can easily be replaced.



The sandal of spikes is made in three sections to allow for the bending of the foot

The Clock in the Tower

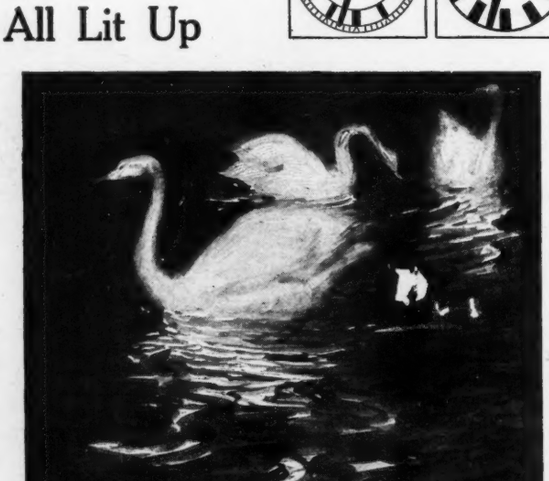
A plain, untrimmed face is the best kind —that is, for a clock

Swans that Are All Lit Up

THERE are strange swans in France, according to Delacour, a French scientist. By day they look like other swans; but at night they are lit up.

How they do it, no one knows. Delacour suggests that their light is merely the phosphorescence of fungi—the fungi being the tiny spores of mushrooms which have attached themselves to the swans' feathers as they rubbed against rotting tree-trunks in the daytime.

The luminosity of the mushroom spore is simply part of its business of living. Some of the food it eats is transformed into energy, which manifests itself in light. This appears in the presence of oxygen, being connected with the fungus' breathing.

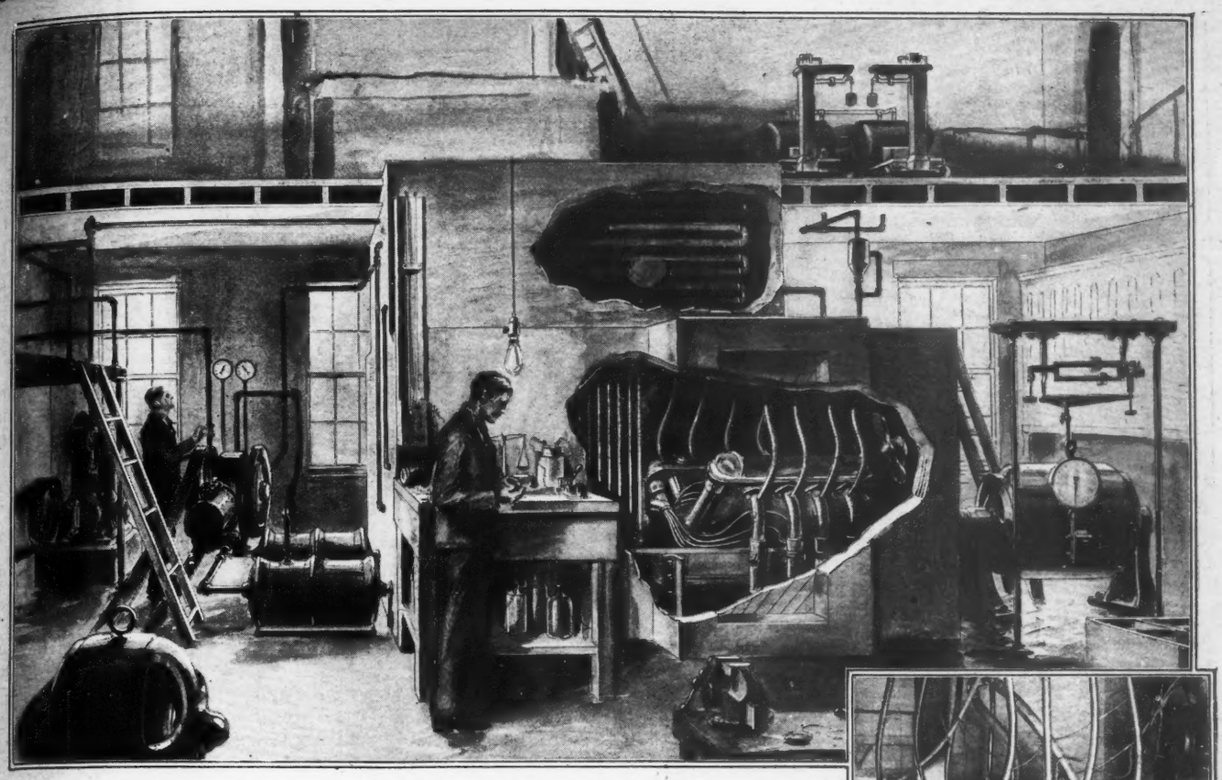


Though they are undoubtedly lit up, the condition is due to phosphorescent mushroom spores

A CLOCK'S primary job is to mark time. The clock may be a work of art, but that should not hinder usefulness.

That is what is the matter with the new clock in the tower of the City Hall, New York, says James Arthur, a master horologist of Brooklyn. The hands are gracefully slim, but they cannot be seen from a distance.

Mr. Arthur suggests a clock dial more plain and severe than that of Philadelphia's City Hall clock, which has a spade hour-hand easily distinguished from the pointer minute-hand. Each hour mark is a heavy, thick plain black line, but relieved by a fancy rim of minutes around the edge. Mr. Arthur's suggestion omits the minute relief.



After going through the test in the "altitude chamber" the airplane engine will be at home in any altitude. Its power is measured by an electromagnetic dynamometer outside the chamber

High Altitudes Brought to Sea-Level

How airplane engines are tested

IF you wish to ascertain whether a substance will melt at a temperature of 400° Fahrenheit, what do you do? Simple enough: you make a practical test by heating the substance to a temperature of 400 degrees.

It is not always easy to make practical tests under the correct conditions. Take engines, for instance. It is a simple enough matter to try out a stationary engine. Its environment remains practically unchanged. There may be some variations in temperature, air-pressure, humidity, and other atmospheric conditions; but these changes are, as a rule, neither abrupt nor formidable enough to be of material influence upon the efficiency of the engine.

Tests for Airplane Engines Different

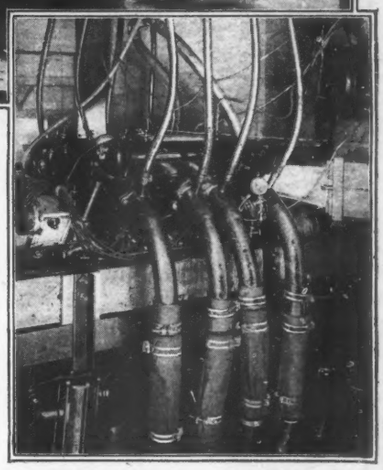
It is different, however, with the engine of an airplane. Under ordinary working conditions, the engine of an airplane rising to high altitudes may pass from one extreme of air-pressure and temperature to the other in a few minutes. If we wish to ascertain what effect on the efficiency of the engine such varying conditions may have, we must try out the engine under conditions closely resembling those under which it would be expected to do its work. It is obviously desirable to make those practical tests before the engine is permanently installed in an airplane.

For the purpose of testing airplane engines under conditions closely resembling those of actual flight, the Bureau of Standards at Washington has established a testing plant commonly known as the "Altitude Laboratory."

In the Altitude Chamber

The testing chamber, in which the engine is mounted in a manner reproducing its mounting in an airplane, is a room fifteen feet long, six feet wide, and six and one half feet high, with concrete walls a foot thick. These walls are insulated on the inside with cork.

The dynamometer for measuring the power developed by the engine is outside of the chamber, and so are the scales for weighing and continuously registering the amount of fuel used, the water-meter for the cooling water, the gas-meter for the air intake, the gage for showing the exact degree of air-rarefication within the chamber, and the dials of the electrical thermometers registering the temperatures at different points on the inside of the chamber.



Pipes and wires connect the mechanism in the chamber with the outside world

The chamber is chilled by an ordinary ammonia refrigerating plant, and, to produce a wind effect, the icy air inside is violently agitated by electric fans. Two electric motors of forty and fifty horsepower drive the refrigerating and rarefying plants. To assist in the maintenance of a low air-pressure in the chamber, cold water is injected into the exhaust.

The dynamometer, which measures the power of the engine with wonderful exactness, consists of a generator driven by the crank-shaft of the engine. The pull exerted by the revolving armature of the generator against its movable magnetic field is transmitted by levers to a scale which indicates the force of the pull in pounds and fractions on a dial. The current from the electric generator is absorbed in resistances or fed to the regular line wires from a switchboard, and may be used to drive other machinery.

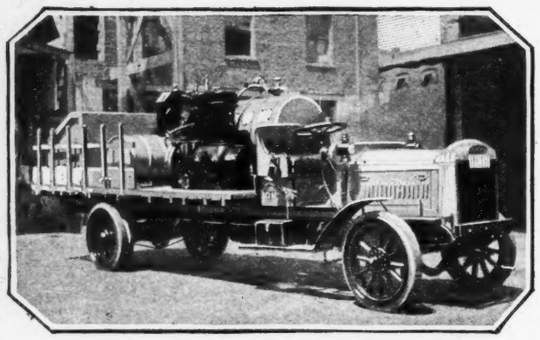
The air-compressor up front supplies air to the winch behind, which operates a scraper that scoops up dirt

The hand on the dial automatically indicates the exact weight of the load resting on the platform scale

It Works by Air-Compressor

TRENCHES are not used exclusively by soldiers: water-mains, for instance, spend the greater part of their lives in trenches. But a water-main's trench has to be refilled after the main gets in.

The Los Angeles method of filling in is a good one. When a trench is dug, the dirt is piled up along its side so that pushing it back will be easy. It is then scooped up and dropped into the trench by a scraper worked by a cable and winch.



This truck carries the air-compressor, being connected with the winch by a fifty-foot pipe

The winch, mounted on a truck that moves along the edge of the trench, is operated by air supplied by an air-compressor likewise mounted on a truck. The compressor travels along some distance in front of the winch. The winch and compressor are connected by a fifty-foot pipe from the compressor and a rubber hose from the winch, for supplying the air to the winch. They are also connected by a rope which pulls the winch near the compressor, a few feet at a time.

Speeding Up the Beam-Scale

A PUBLIC weigher does a good day's work if he takes the weight of one hundred car-loads or wagon-loads. To run the car or truck on the platform of the scale takes time, but much more time is consumed in adjusting the weights and reading the record from the scale on the weighing-beam.

With an automatic scale like that shown in the accompanying picture a great deal of time may be saved, and a weigher can easily take the weights of four hundred truck-loads in a day.

This scale is built on the principle of a bridge scale. It has no springs to get out of order. By a system of levers the weighing-beam is connected with a graduated dial on which the hand of the indicator shows the weight in pounds. The highly sensitive scale is calibrated to indicate automatically weights from ten or twenty pounds to several tons.

These scales are used in many industrial establishments where careful records of fuel consumed must be kept.

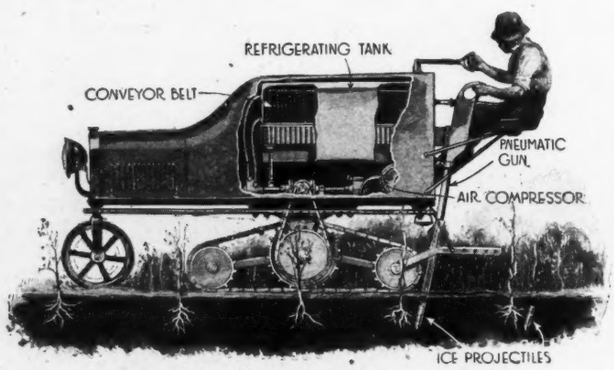
Will Plants Thrive on a Diet of Icicles?

SHOOTING icicles from a gun at innocent plant roots is the cherished dream of E. F. Reid, of Texas. In fact, he has invented and patented a machine that will move stealthily among its unsuspecting victims, making icicles all the while and feeding them to a gun at its rear, which is pointed with deadly accuracy at the unprotected roots.

The object of this strange procedure is irrigation. When the trigger is pulled, an icicle speeds downward, making a hole in the ground, which is promptly pushed in after it by other parts of the machine. Thus entombed, it leisurely melts, affording the startled roots ample time for absorbing maximum moisture.

The machine is a tractor having a single wheel up front for steering and three sprockets in the rear, with a tractor chain driving around them. Up above the single wheel is the engine, and above the sprockets a refrigerator where the icicles are made. There are two tanks in the refrigerator: one holds the freezing mixer and the other holds the water to be frozen. The water is poured into small bullet-shaped molds connected with the refrigerator.

When the water has turned to ice the bullets are dropped into an endless conveyor connected with the gun. Just behind the gun is the seat from which the driver steers and shoots. Whatever power is needed the engine supplies.



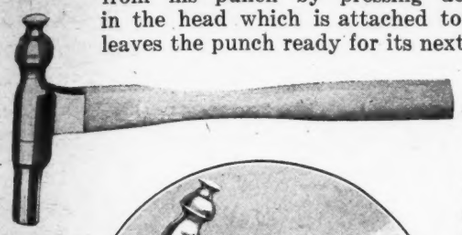
We have yet to learn whether the plants appreciate being fed ices in hot weather

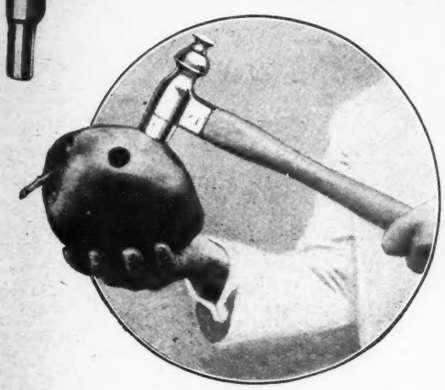
Milking the Cocoanut

NICOLAS Gunturiz, of Cuba, has patented a cocoanut punch—not a drink with a kick in it, but a hammer with one, to kick holes in cocoanuts. There are those who would gladly drink cocoanut milk; but the skin is so hard to crack that the milk is usually spilled when the break comes. The cocoanut punch of Gunturiz, which is shown in action here, punches neat holes into the heart of cocoanuts so that the milk can flow freely.

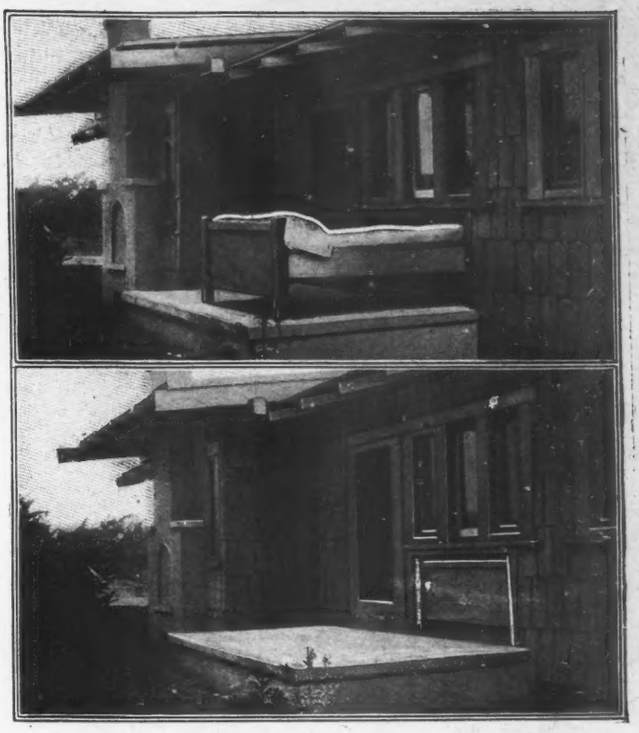
The punch is made and used like a hammer. A hollow tube with a sharp cutting edge is attached to the hammering end of the head. The puncher hits the cocoanut a blow, and the cutting edge of the punch sinks deep. When the punch is pulled out, it takes with it the piece of cocoanut it has cut, leaving a hole for milking.

The puncher removes the cut of cocoanut from his punch by pressing down a piston in the head which is attached to a disk. This leaves the punch ready for its next cocoanut.





When the puncher hits the cocoanut a blow with his hammer-like punch, the hollow tube with its cutting edge sinks in, leaving a round opening through which the milk is easily drawn



When the bed is in its bedroom the headboard acts as wall; but at night-time the bed is pulled out like a drawer

The Bed Is Part of the Wall

ALL southern California has decided to sleep out of doors in fair weather, and so the house-owners are busily building sleeping-porches on their second stories. One poor house-owner was worried. His was a one-story house, and he shied at the idea of exposing his bed to the eyes of the neighbors all day long, yet he didn't want to go to the trouble of carrying it out stealthily each night and returning it in the morning.

Being an ingenious person, he made a drawer out of his bed—pulled it out of the house wall at night, and pushed it back into the room in the morning. Outside of his bedroom window he built a concrete porch level with his bedroom floor.

Then he colored the bed to match the house; for the head of the bed plays wall in the day-time, and the foot at night. Both head and foot fit so snugly that the wall surface is unbroken.

At night, if the weather is fair, the owner pulls out his bed and sleeps under the stars. If the night is stormy, bed and sleeper remain indoors in comfortable dryness.

There is one disadvantage, however, which can be plainly seen in the illustration. The distance from the mattress to the top of the hole in the wall is so small that not even an extremely thin person could squeeze through with the bed. And so if it should rain in the night, the bed could be swiftly and safely pushed inside, but the barefoot owner would have to wade through the mud around the house to the front door.

Love Me—Love My Dog

TRAINMEN and travelers object to dogs in passenger-cars, insisting that they are baggage and should travel with the trunks. This seems very strange to the offended owners of prize "Peks," who of course could not consider such a thing. When these owners travel on trains they simply cannot part with their pups.

Dog-bags solved the problem—most of them being improved satchels with air-holes in them. Here is a dog-bag *de luxe*. It is large enough to give the dog plenty of room to move in; it is well padded with blankets; and it has a large glass window in front. This window allows the dog to look out on the world and keeps it from getting lonesome. It also allows the anxious owner (I will not call her mother) to look in at her precious child to see how it is faring.

Provided the animal does not howl, trainmen and travelers will not object. These pampered puppies simply will not suffer rough treatment. Were they put in the baggage train with the unbeautiful trunks, they would sulk for days, refuse to eat, get sick, and stir things up generally.

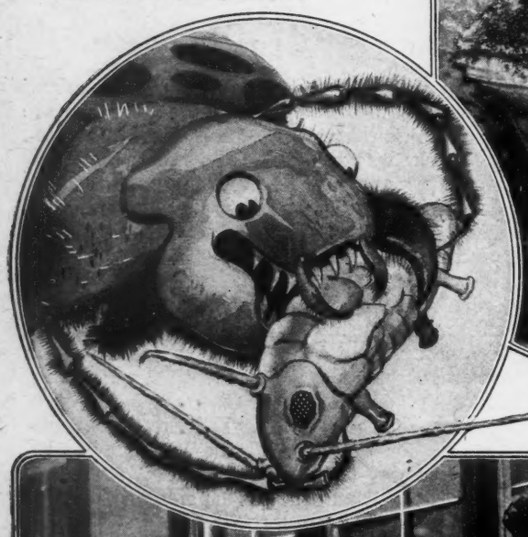
A dog's life is not always as Charles Chaplin pictures it. Behold these pampered animals, which are shielded even from harsh words

Lady-Bug, Lady-Bug, Fly Away to France!

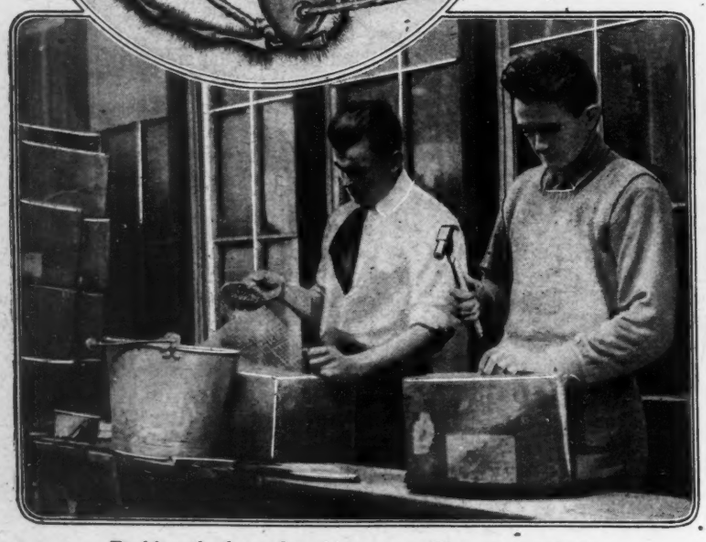
Photographs © International Film Service

In their mountain camps the bug-hunters fill large sacks with the lady-bugs while they are still enjoying their winter sleep. They go by mule-back and train to cold-storage plants, where they are kept until the signal to attack

Lady-bugs hibernate in large colonies. They are gathered by the handful and dropped through a sieve-topped sack to separate the bugs from the dirt and leaves. So plentiful are they that two men can gather one hundred pounds of lady-bugs in a day



A million lady-bugs have gone from California to France to battle with the plant-lice, which threaten the sorely needed harvest. You may think of lady-bugs as pretty little beetles; but the magnifying-glass shows one as the aphis sees him—a tiger-like creature with jaws to break bones and hooked antennae for seizing his prey



Packing the bugs for shipment. There are 330,000 bugs in each box. About 30,000 form an army corps calculated to clean up any average acre of plant-lice

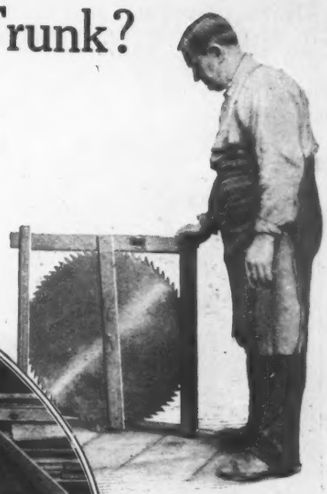
So many are the lady-bugs—and, by the way, they are usually gentlemen-bugs—in some places that they may be shoveled up in scoops

Where Is My Wandering Trunk?

Standing next to a boiler in the express company's graveyard

While this velocipede waits the boy it was bought for is growing up. If he doesn't claim it soon he'll find—as its keeper has—that he won't fit

Two boilers that have never boiled and may never boil! They have lost their address tags



A buzz-saw with its teeth all sharpened and its sides shining — eager to buzz and saw. The wood and its owner are waiting too. But where?

A little corner of "No Marks" land. Here the unidentified pipes, castings, hardware, engines, chains are piled up so that they look like junk; in fact before long they will probably be sold as junk

Just another graveyard tragedy: two orphaned fire hose wasting their lives away amid unappreciative surroundings—wheels, cans, pipes, and grates. Where, oh where is their engine?

Eyes popping, ears flapping, lips smiling, this mask started off for the Mardigras. Apparently no one has told him that he may never get there, for he is still smiling and showing his teeth. Little does he realize that he is playing corpse!

Because of its insulation this motor will work under water. It is pumping the water out of a sunken ship

The Water-Proof Motor Pump

AN article in a recent number of POPULAR SCIENCE MONTHLY detailed many ways of "lifting sunken treasure from the sea." But why let the treasure sink in the first place? Why not salvage stricken ships before they get a chance to go down?

Here is a motor pump which in many cases will keep a ship up if present at the time of the accident, or will raise her if she is already sunk. The reason is that the motor is not afraid of water, and will work as well below it as above. In an ordinary motor the water would soon penetrate the insulation and cause a short circuit. The secret of this motor is a new kind of insulation which waterproofs the wires.

Every ship should have one of these motor pumps in each of the main compartments and an emergency oil-driven generator on an upper deck for use in case the ship's main plant should fail. Then, if a hole should be ripped in the ship's side, the motor pumps could be started and the inrushing water pumped out, enabling the ship to hold its own until help arrived.

In the case of a sunken ship divers take motor pumps down into the hold and fasten them in the proper places. They are connected by wires to electric generators on salvage ships, which may be either alongside or far away. These pumps are said to be perfectly safe in storms.

Where Is That Airplane?

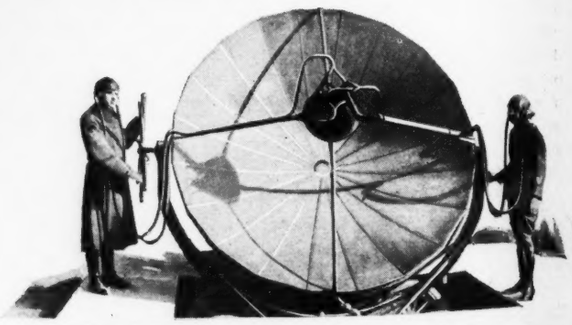
AIRPLANES in flight make a noise that at close range is almost deafening. The human ear, unaided, can detect the noise of an airplane in flight at a considerable distance, but it is extremely difficult to locate the direction from which the sound comes.

A number of different systems of sound-collecting instruments were used by the Allied armies for locating airplanes, especially at night. Two of them are shown below.

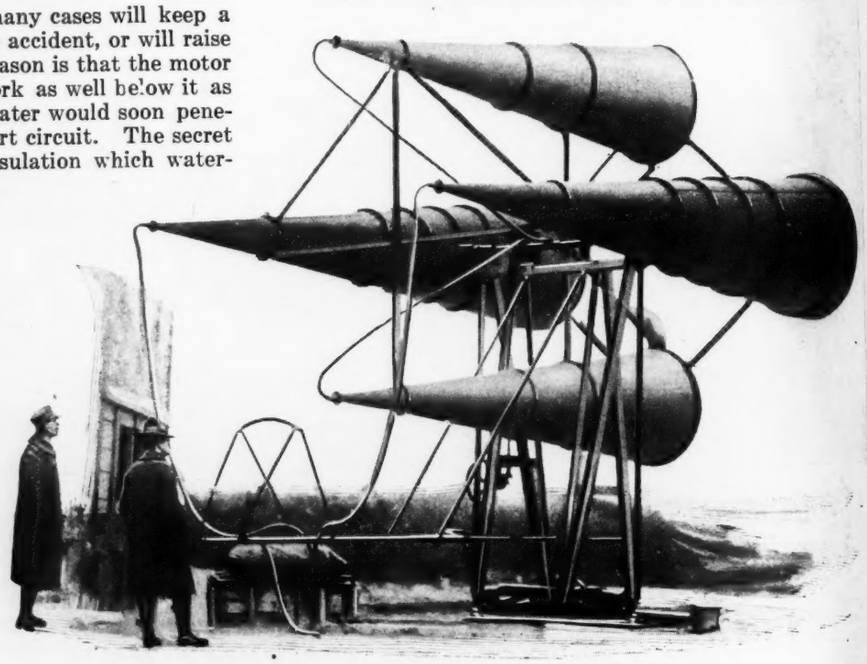
In one of them four large conical tubes are supported by a tiltable framework resting on a turntable. The wide-open ends of the horns are turned toward the enemy to catch the faintest sound coming from that direction. The sound waves, thus collected, are amplified at the narrow ends of the tubes by microphones, and are then carried to the observer through listening-tubes.

The parabolic sound-collector shown in the other picture consists of a light shell formed like the reflector of a locomotive headlight, supported by a framework resting on wheels. The parabolic cup collects the sound waves and reflects them to the microphone, which is placed in the focus of the shell. The microphone amplifies the sounds and, through a double tube, transmits them to the observer.

The range of this apparatus is about three and one half times that of the unaided ear.



This large but easily transportable sound-collector made it possible to locate airplanes flying at night, so that they could be illuminated by searchlights and fired on



An airplane detector that can accurately locate an airplane at a great distance, but is too unwieldy for quick transportation

What Holds the Stars Together?

Gravitation, the all-pervading force

By Alfred J. Lotka

A HEALTHY man weighing three grains? Ridiculous! Nevertheless, it is true.

You see, it all depends. Weight is a relative thing. The earth pulls you down with a force of, say, 150 pounds weight in New York. But, at the same time, the moon in the sky is pulling you up, and so far as the moon is concerned you weigh, at New York, about three grains—about as much as a fly.

The Moon Constantly Pulls Us

The reason why you weigh so little relatively to the moon is that the moon is only about one eightieth of the earth in mass, and that it is so far away—about sixty times as far from New York as that city is from the center of the earth. Still, even so, and at that distance, the moon is constantly pulling you toward her with this weight of three grains. You do not notice it because the earth is holding you down with so much greater force. But if the earth and the sun were suddenly removed and all motion were arrested, leaving you hanging in space, you would immediately begin to fall toward the moon. It would not be a very hasty fall, it is true—at least, not at first. You would have plenty of time to think about your misfortune, for it would take you over two minutes to fall one foot! You would, in fact, be quite unconscious at first that you were falling. Still, when, after a long time, you reached the surface of the moon, you would have gained speed, and you would land there at the rate of 7,780 feet per second. (So, after all, it is well the earth does not suddenly abandon you to the attraction, gentle but firm, of the moon.)

By the time you reached the moon you would weigh twenty-five pounds; and you would astonish the natives by unheard-of acrobatic feats

As you approached the moon not only your speed but also your weight would increase. You would not regain your full earthly dignity of 150 pounds, but at least you would be saved the humiliation of those miserable three grains. By the time you reached the surface of the moon, supposing you were somehow able to break your fall, you would step about lightly in your new surroundings with a weight of 25 pounds. You would astonish the natives (if there were any) by jumping over their houses and performing other unheard-of acrobatic feats.

However, the moon is not a healthy place to stay on. Temperature conditions are very uncomfortable, and there is no air. So we are not much interested in any athletic prowess which we might develop there.

The case is a little different with the planet Mars. According to Percival Lowell, Mars is probably inhabited. Now, on Mars a 150-pound earth-man would weigh about 53 pounds, say in round numbers about one third of his earth weight. Here is a problem: How big could nature afford to build a Martian man without putting a greater load on every square inch of the soles of his feet than a 150-pound earth-man rests on his? The answer is that the Martian could be made three times as tall, say 17 feet 6 inches. For if he stood on the earth his weight would then be $3x3x3x150 = 4,050$ pounds; but on Mars it will be only 1,350 pounds.

If an ordinary man touches the ground with his feet over an area of about 50 square inches, our Martian would stand on $3x3x50 = 450$ square inches. If, then, we figure out the number of pounds borne by each square inch, we find for the ordinary man on earth $150 \div 50 = 3$ pounds. For the Martian 17 feet 6 inches high we find $1,350 \div 450 = 3$ pounds, just the same. We see, therefore, that the Martian could be built on three times the scale in height, breadth, and depth as an ordinary man; and though he would, on earth, weigh more than two tons, this would not put any greater tax on his feet on Mars than that which is normal for us on earth. Yet this Martian giant, though in no way encumbered by his own weight, would be twenty-seven times as powerful as an earth-man. In certain special operations where the work consists in overcoming gravity, such as digging canals, he could accomplish $3x27 = 81$ times as much as an earth-man on earth, since Martian gravity is only one third that of the earth.*

On the moon and on Mars gravity is less than on the earth. On the planet Jupiter it is more than 2½ times as great as here. A 150-pound earth-man on Jupiter would be weighed down with a load of 390 pounds. Walking would be a very tiring process. On the sun gravity is more than 27 times that on earth. If the sun were solid and the temperature such as to permit the presence of life, an earth-man on its surface would not only be utterly unable to rise into a standing position, but even when lying flat on his back he would be crushed by his own weight of more than two tons. If there were sun-men they would not exceed 2½ inches in height.

Influences Every Phase of Life

So then the size of man, and of every living creature, is determined, among other things, by gravitation. But that is only a minor detail.

Gravitation has a fundamental influence on every phase of life. What makes a plant shoot its stem upward, its branches sideways, its roots down into the soil? Gravitation—at least, in part. What keeps the earth shrouded in the atmosphere from which you draw your life-breath? Gravitation. What keeps the earth from flying off at her speed of 18½ miles per second into the dark recesses of space, where, far from the sun's warm rays, not only would all life perish from cold, but even the air would freeze solid? And what holds

*This estimate is somewhat excessive because we have used the round figure 3 instead of the accurate 2.65; but it will serve to illustrate the principle.

the moon in its course around the earth? Gravitation. And so on, indefinitely. How does it all come about? A partial answer at least can be given to some of these questions.

The response of plants to gravitation is strikingly illustrated in the life-plant, so called perhaps because of its extraordinary vitality. A single one of its leaves may be cut into thirty pieces, and from each piece, when sown on the moist ground or suspended in moist air, a new plant will grow. If a piece of the stalk of this plant is hung up horizontally in a moist atmosphere it starts to grow. But it grows all on one side, the lower face only, with the result that it acquires a curved outline. If we paint black marks or rings around the stem, it can be seen how the space between these remains unchanged at the upper face, but how the rings spread apart on the lower face in consequence of the growth. A seedling planted horizontally in a vertical surface of soil will very soon curve into an S shape, the stem growing upward, the root downward. The explanation of all these effects probably is that certain substances collect by their weight toward the bottom of certain parts of a plant, causing increased or diminished growth.

Not only plants but animals also display geotropism, as this property of being directed by the earth's gravitation is called. A certain aquatic animal known as the sea-cucumber, if placed on a flat plate, will keep on climbing vertically upward no matter how the plate is turned. The only thing that guides it is gravitation. There is no other inducement for it to seek the highest point in the plate.

Is man geotropic? He most certainly is, though in his case gravitation does not direct the course of his steps but merely regulates his erect position.

If you suppose that this does not require any special faculty, just call to mind the actions of a drunken man. How is the regulation accomplished? By means of a system of "spirit levels" carried in the head, the so-called semicircular canals of the inner ear. Injury to these canals causes more or less acute symptoms of dizziness or inability to maintain equilibrium.

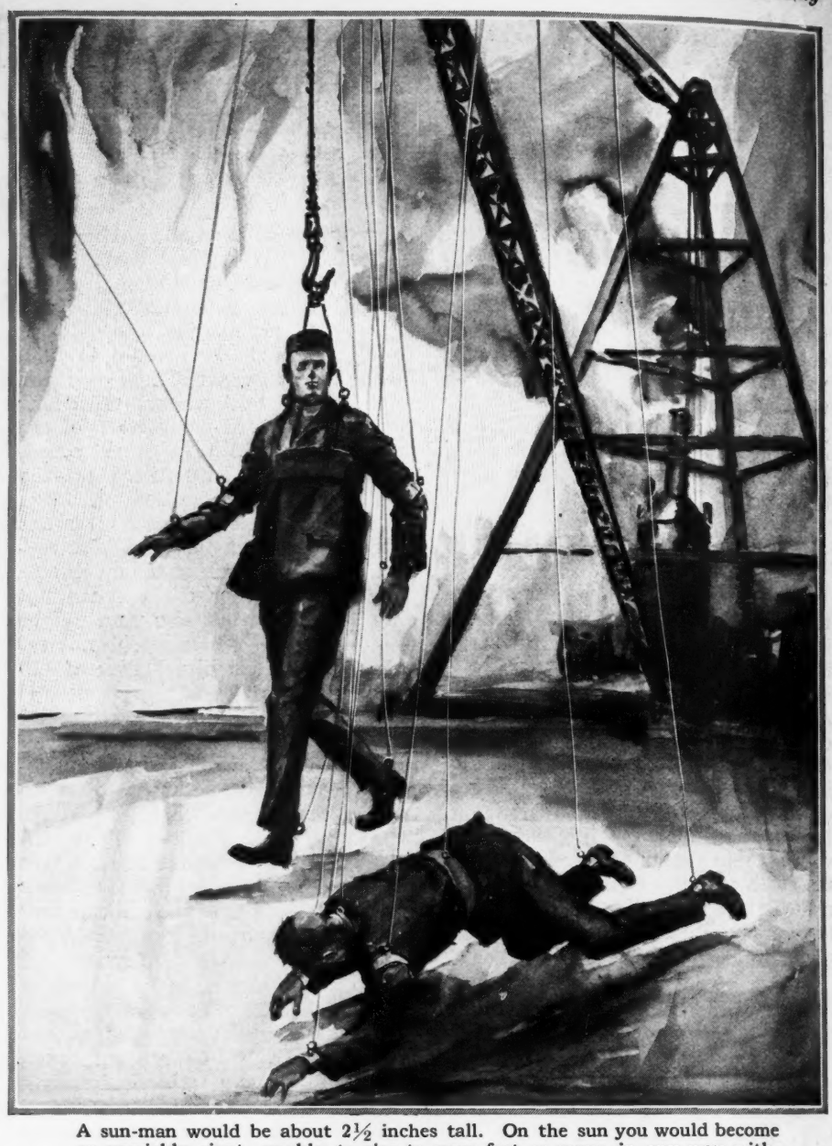
Spirit Levels in Our Ears

The greatest freak in the matter of geotropism is a little crustacean known as Palæmon (the prawn). This creature has a most extraordinary method of solving the problem of keeping on an even keel. It possesses an apparatus similar to the spirit level of our inner ear, but within its liquid are little loose particles of grit, so-called otoliths or "ear-stones." It appears that these, by their pressure against the bottom or the sides of the space containing them, indicate to their owner whether he is steering an even course, or whether he is tilted this way or that. Now, the remarkable thing is this: At the time of moulting, Palæmon loses his otoliths or ear-stones. So what does he do? He coolly picks up sand from the bottom and puts it in his ears; and he goes on his way rejoicing, with the confidence of the man who has not touched a drop for a year. Even that does not exhaust Palæmon's repertoire of tricks. One ingenious biologist conceived the idea of giving Palæmon iron filings to put in his ears instead of sand. The obliging creature promptly inserted them, and lo and behold, Palæmon had developed a new sense: he responded to a magnet somewhat after the fashion of an animated compass needle! He had become magnetotropic.

To understand how the atmosphere is tied to the earth by gravitation, we must form a mental picture of a gas, such as the air. Can you call to mind the appearance of a swarm of gnats dancing in a sunbeam? How they flit to and fro and up and down with irregular motion? If your powers of sight could be increased about ten million times the air might present to you an appearance not unlike that swarm of gnats. For the air consists of innumerable particles (molecules) of diminutive size, flitting about and jostling each other, now colliding like billiard balls, now flying apart, now hitting against the solid objects of which the visible world is composed.

Just as would be the case with a jumble of billiard balls rolled at random on the table, the individual molecules have all kinds of different speeds. But the average speed of a large number of them is definite, and depends on the temperature. At 60° F. the average speed of the molecules of the air is about 1,500 feet, or something over ¼ mile, per second.

Now, if you read the article in the

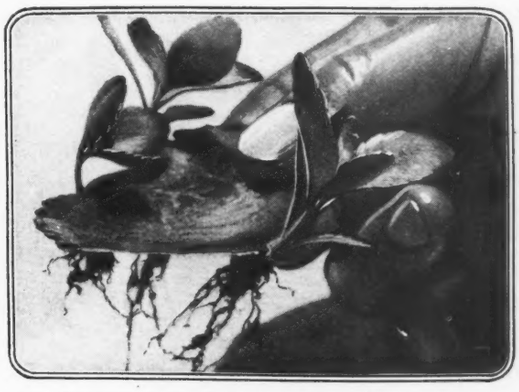


A sun-man would be about 2½ inches tall. On the sun you would become an unwieldy giant, unable to rise to your feet or move in any way without the assistance of puppet-strings manipulated by high-power cranes

April issue of POPULAR SCIENCE MONTHLY on "Hurling a Man to the Moon," you may remember that to shoot a body off the earth so that it will never return requires a velocity of about seven miles per second. You will therefore see that a molecule of the air, at the average speed at 60 degrees, can never leave the earth.

This is not saying that some of the more rapidly moving molecules might not do so. However, it can be shown by a complicated calculation that, if the earth loses any of its atmosphere at all, the loss is so slow that even after millions of years it would not be noticeable.

So then the inhabitants of our globe are guaranteed against an air famine for many generations to come. How about the other planets? Computation shows that they too are provided for, though Mars is losing or has lost its hydrogen and helium, both of which are much lighter than air. The moon, on the other hand, is quite unable to hold an atmosphere, and is well known to be devoid of any.



The same force that keeps the earth from flying off into space makes a plant shoot its roots down, its stem up, and its branches sideways. This response of a plant to gravitation is particularly marked in the life-plant, so called because from a single leaf thirty new plants may grow

Weight Is a Relative Thing

The earth's gravitational pull falls off as the distance increases. A stone weighing one pound at the earth's surface, four thousand miles away from the center, will weigh only one quarter of a pound if taken to a point out in space four thousand miles from the surface or eight thousand miles from the center. In other words, if the distance from the center of the earth is doubled, gravitative attraction is reduced in the proportion of 1 to the square of ½. This is the law discovered by Newton.

But if, instead of going out into space, we make a deep bore-hole in the earth, how will gravity vary as we go down?

If the earth were a uniform perfect sphere, gravity would decrease as you go down into it. But, as a matter of fact, the central portion of the earth is more than twice as dense as the crust, and for this reason the weight of a body increases as you go down; though, if you could go far enough, a point would undoubtedly be reached where gravity would begin to decrease, becoming zero at the earth's center.

Weight is a relative thing. It changes not only as you burrow into the earth or fly out into space, but it even changes from point to point as you travel on the earth's surface. If your weight were 150 pounds at the North Pole, it would decrease by three quarters of a pound as you traveled to the Equator. There are two reasons for this change in weight. One is that, owing to the flattening of the earth at the poles, you are nearer its center there than at the Equator. The other is that at the Equator, owing to the earth's rotation, you are carried around in a circle with a velocity of about seventeen miles a minute, and a part of the earth's pull is spent in keeping you from flying off at a tangent. This part of the earth's attraction, about one three-hundredth of your weight, is not indicated by any kind of balance.

Supposing the earth were all alone in space, you could not tell by looking at the stars whether it was rotating or not. You would not know whether your weight was 150 pounds on a stationary earth, or 300 pounds on an earth revolving with such speed that one half your weight was taken off your feet by centrifugal action. In other words, you would have no way of distinguishing between gravitational force and the effect of inertia.

This inability to distinguish between gravitational and inertia effects is the root of the modern theory of gravitation. It is impossible to enter here into the details of a rather abstruse mathematical argument. But perhaps some indication of the nature of the theory can be given by stating that according to this theory the presence of a portion of matter, such as the earth, produces a kind of strain in space.

The theory has, so far, yielded one important concrete result. It accounts for certain observed irregularities in the motion of the planet Mercury which could not be explained in any other way.

The Moon's Grip on the Earth

Although, as we saw, the moon's gravitation is insufficient to hold the elusive molecule, it gives her a grip upon the earth, the strength of which may be illustrated as follows: If, instead of gravitation, we had to rely upon a steel bar to tie the moon to the earth, this bar, 240,000 miles long, would need to have a diameter of 225 miles to sustain the pull required to keep the

A Martian giant could be over seventeen feet high without putting any undue strain on his feet. In the way of digging he could do the work of fifty men on the earth. On the sun you would have to be shrunk to two and a half inches if you wished to retain an upright posture without strain

moon circling around the earth! If the moon is being constantly pulled with this great force, why does it not fall to the earth?

The answer may be a little surprising. The moon does fall; it falls about one nineteenth of an inch every second. This does not mean that it is approaching the earth. But, instead of traveling on in a straight line, as it would without the deviating effect of gravitation, it is as it were, drawn aside by one nineteenth of an inch every second and thereby kept circling in its path around the earth.

By the way, why should the moon complete its cycle between two full moons in 29½ days? Has the lunar month always been of this length? And where did the moon come from?

These are not idle questions. The astronomer has an answer ready for them. The clue to the mystery is found in the tides. The moon, by her gravitational pull, raises on the earth two tides, one on the near side, the other on the far side. Between these two the earth rotates as between two brake-shoes. The obvious result is a very gradual slowing down of the earth's rotation. A little less obvious is the reaction on the moon. As the moon in its revolution lags behind the faster-moving earth, the first effect would be for the earth to hasten on the moon in its travel. But, instead of giving way directly to this impulse, the moon recedes farther away from the earth, and actually slows down. The net result is a gradual lengthening of the day, and at the same time a more rapid lengthening of the month, while the moon is slowly, very slowly, getting farther and farther away from the earth.

But if the moon is moving away from the earth, then formerly it must have been nearer to it; and if we go back far enough in time, what then?

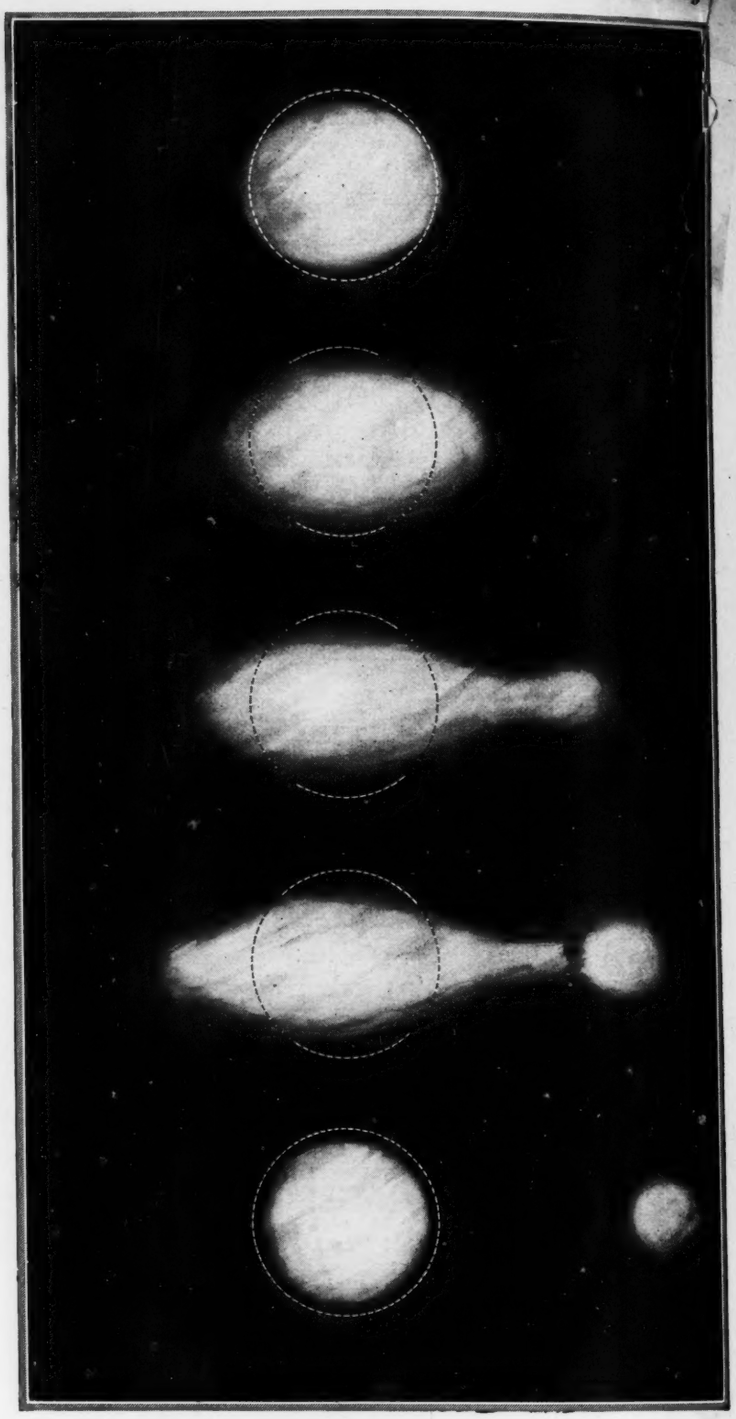
Now, this is not a matter of guess-work. Astronomers can compute these things. When the day was about three hours long, the month was also three hours, and the moon was grazing the earth. In other words, the moon was originally part of the earth, and was thrown off by some catastrophe. What was the cause of this catastrophe?

The Birth of the Moon

Here also the astronomer is ready with an answer. The earth is more or less plastic. In those days it may have been more so than it is now. It may have been largely liquid. Now, a plastic or liquid body of the shape of the earth is capable of vibrating, somewhat like a church-bell. Such a bell has a definite period or frequency, so many vibrations per second, according to its size and pitch. In the same way, the earth has a natural period of vibration, which can be approximately computed. It is found to be about 1½ hours for one vibration.

Now the sun raises two tides in a day. In the three-hour day it raised a tide every 1½ hours. But this is the natural period of vibration of the liquid earth. The globe, under these conditions, was thrown into gigantic pulsations of ever-increasing violence. Year by year the vast wave stormed to greater and yet greater heights. This world of ours, so solid now under our feet, was throbbing as if its heart-beats would rend it.

And then, one fateful day, the gathering flood rose as a great mountain to the sky, and out of the surging tide the far-flung moon was born.



The Birth of the Moon

This illustration shows in general principle (though not in scale) the process by which, many millions of years ago, the moon was thrown off from the earth by tidal action. The several pictures represent successive stages in the vibration that culminated in the throwing off of the moon.

"The day was at that time about three hours long. Now the sun raises two tides a day. In the three-hour day it raised a tide every ninety minutes. But this is the natural period of vibration of the liquid earth.

"The globe, under these conditions, was thrown into gigantic pulsations of ever-increasing violence. Year by year the vast flood stormed to greater and yet greater heights. This world of ours, so solid now under our feet, was throbbing as if its heart-beats would rend it. 'And then, one fateful day, the gathering flood rose as a great mountain to the sky, and out of the surging tide the far-flung moon was born"

On Fire 7,000 Feet Up

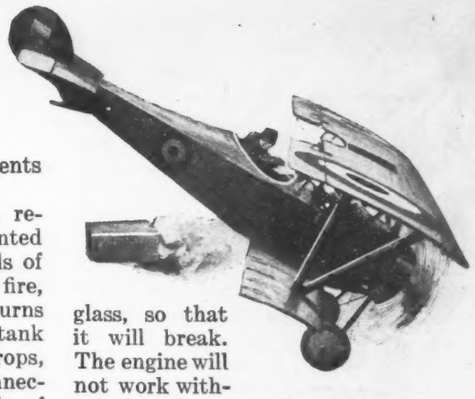
Two ways of fighting the flames

"HE fell to his death in flames." We hear that nearly every time there is a fatal airplane accident. Why must there be that added horror of fire? Because the gasoline-tank bursts into flames at the toss of a spark, and the burning gasoline runs out and envelops the airplane.

There are two ways to prevent this. One is by removing all possibility of air reaching the gas; the other is to remove the tank.

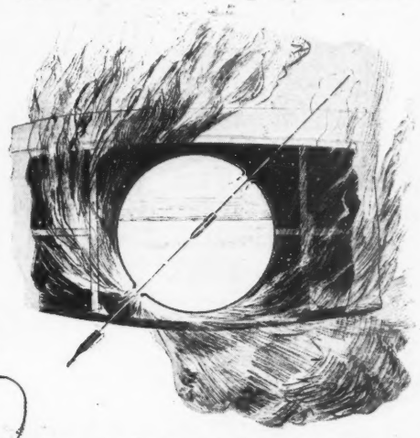
In the first instance, layers of thin rubber are wound around the tank, the outside end being left free. Then the whole tank is inclosed in a thin wire netting. Suppose an incendiary bullet should puncture the tank and go out the other side. The gasoline (perhaps already aflame) will run out the holes and disturb the rubber layers, creeping between them. This increases their diameters and they shift to allow for it. The result is that the free end moves and covers up the hole. This keeps the air from getting in and the gasoline from getting out, and prevents them starting a fire.

In the other method—that is, removing the tank—the tank is mounted on four cams placed near the ends of two rods. Should the tank catch fire, the pilot pulls a handle, which turns the cams around and leaves the tank without support. It promptly drops, taking its flames with it. The connection from tank to engine is made of glass, so that it will break. The engine will not work without fuel, but the pilot has a chance to save his life by gliding to earth.

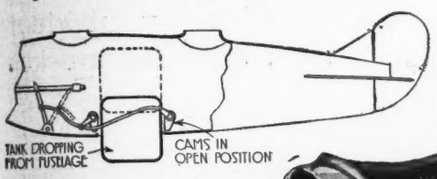


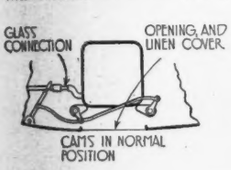
Had our planes been equipped with either of these devices during the war, Raoul Lufberry, America's greatest ace, might not have died. A German bullet pierced his tank and set his plane afire. He tried bravely to put it out, but when he realized the hopelessness of it he crawled out on the wing of his plane and jumped. When his body was picked up, it was found that his only bullet wound was in his thumb.

Lufberry died because one bullet hit his tank.

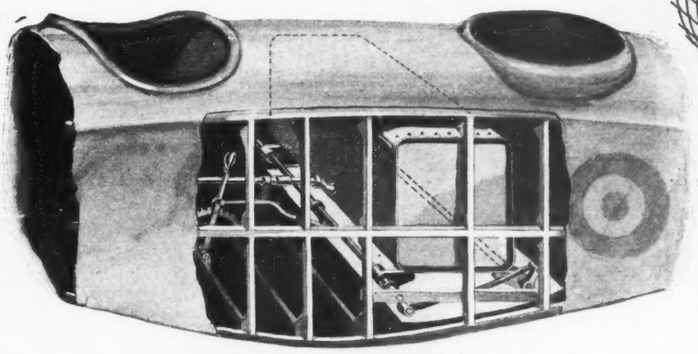


Raoul Lufberry died because a bullet pierced the gasoline-tank of his airplane

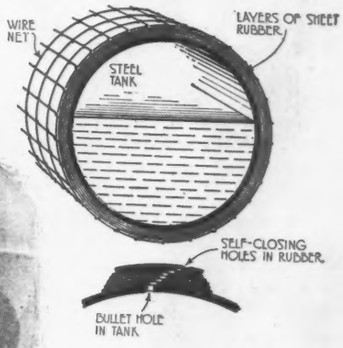




Should the tank catch fire, the pilot pulls a handle that turns the cams on which the tank rests, leaving the tank unsupported; it drops with its flames



A tank like this one drops out on the pull of a lever; of course the pilot must glide to the earth



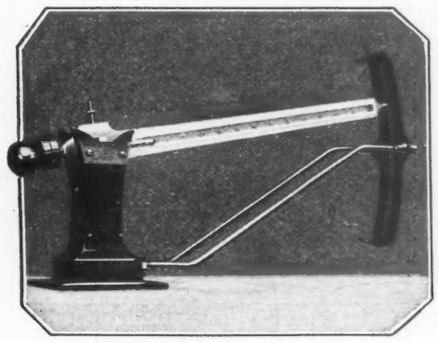
The layers of rubber outside the tank shift and close over the bullet-hole, keeping the gas in and the air out and preventing fire

When the Mercury Goes Up the Thermometer Goes Down

"SEVENTY-EIGHT degrees! I don't wonder it's warm in here," says the blind man. Whereupon you *do* wonder—not at the temperature, but at how the blind man found it out.

Then you see his thermometer—or is it a scale? It is both. The thermometer acts as a pointer on a scale which is marked off in raised Braille degrees. The blind man simply touched the degree on the scale at which the thermometer pointed.

This is how the machine is made: the base is of metal and has a knife-edged top that serves as a fulcrum.



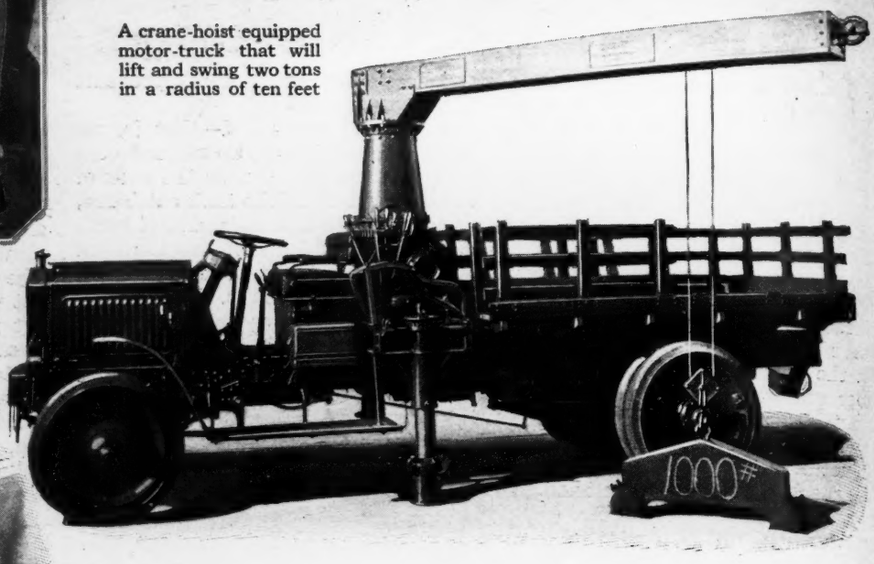
A blind man can read the temperature from the scale marked in Braille

The thermometer, mounted on aluminum, forms one lever arm, a counter-weight and an adjusting screw the other. As the temperature rises the mercury goes up—or, rather, sideways. This increases the weight of the thermometer arm, which consequently goes down.

The thermometer and the scale at which it points are so regulated that they read alike. When it is zero on the thermometer it is also zero on the scale. When the mercury goes up to twenty degrees, the pointer goes down to the twenty-degree mark on the scale, and so on.

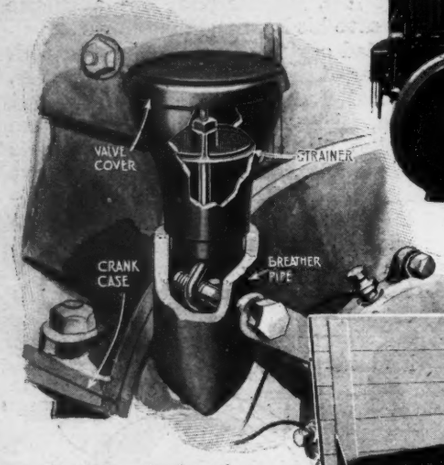
This metal trough attached to the Ford prevents rain or wash water dripping through

A crane-hoist equipped motor-truck that will lift and swing two tons in a radius of ten feet

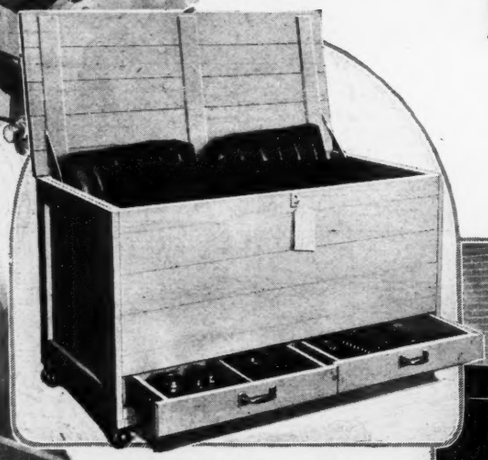


Motordom Is Getting

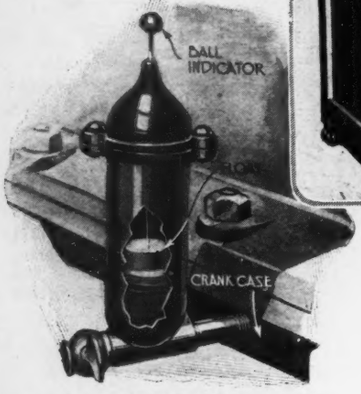
Accessories play important of used cars and trucks:



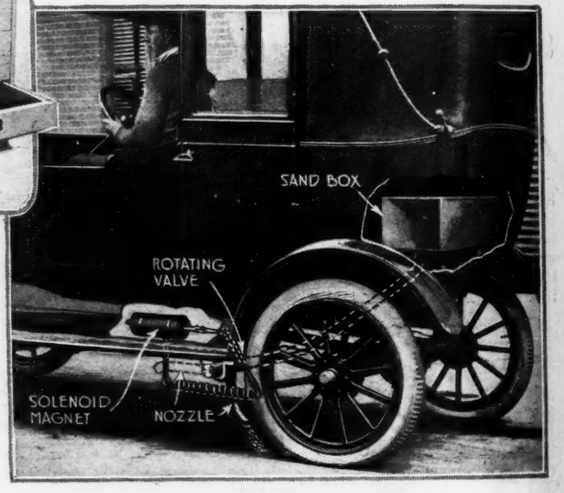
Extending the breather pipe facilitates pouring oil to the crank-case



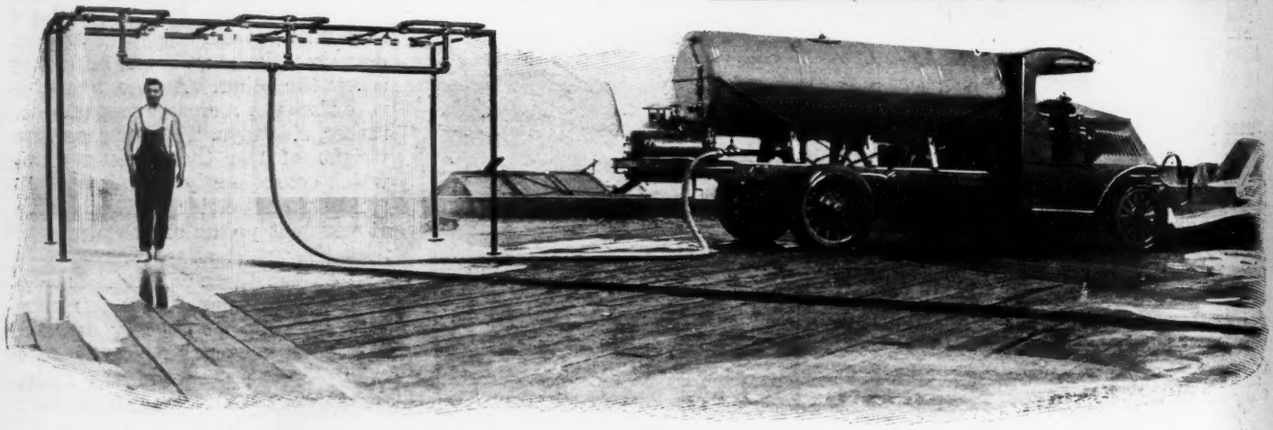
This lockable box of many compartments provides safe storage for the various parts of the car undergoing repairs



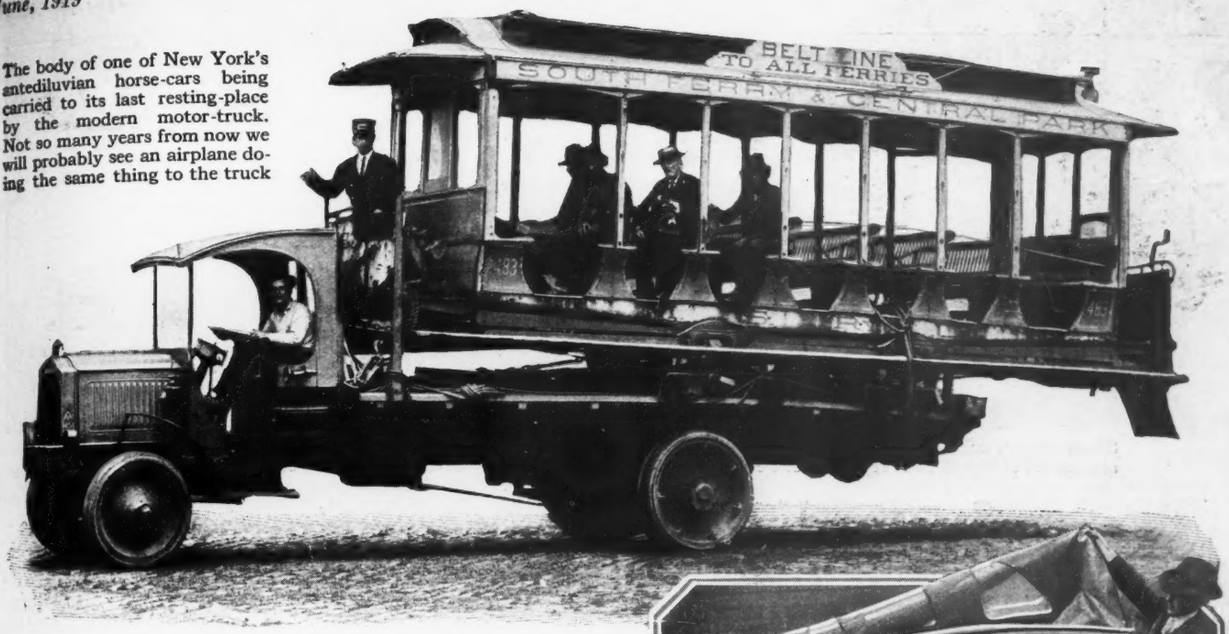
An all-metal oil-gage assures a constant reading of the oil level without the danger of accidental breakage



A switch on the dash operates the rotatable valve of this sanding contrivance shown at the right



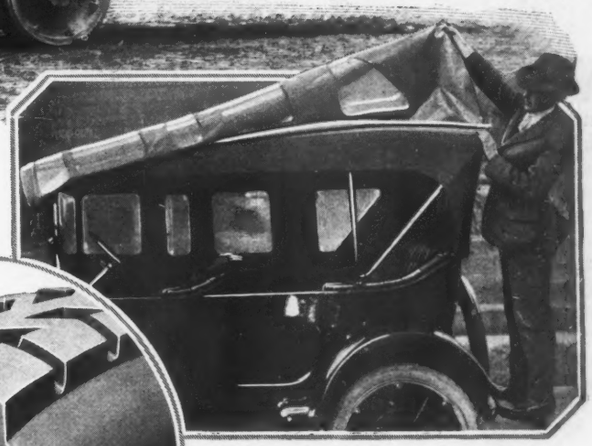
Here is a motor-truck that provides its own shower-bath for drivers by pumping water from tank into heater and then forcing it to the portable shower-pipes



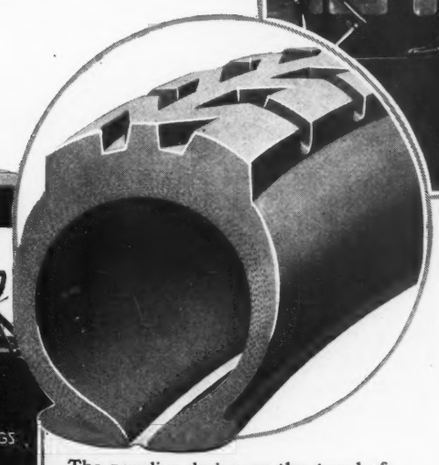
The body of one of New York's antediluvian horse-cars being carried to its last resting-place by the modern motor-truck. Not so many years from now we will probably see an airplane doing the same thing to the truck

Back into Its Stride

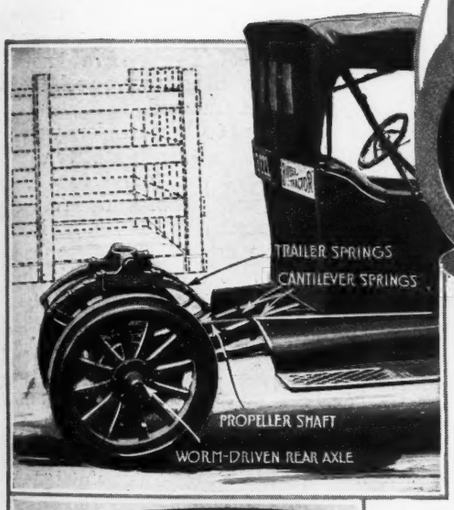
parts in the renovation here are some new ones



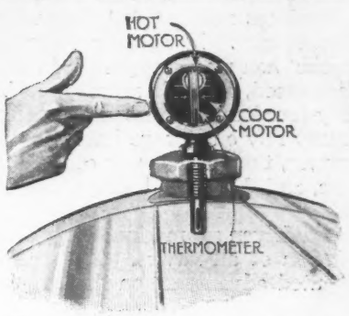
This new detachable top slips over your old auto top and makes it look like new; it is easily adjusted by one person



The peculiar design on the tread of this tire is said to prevent forward, diagonal, and side skidding of the car

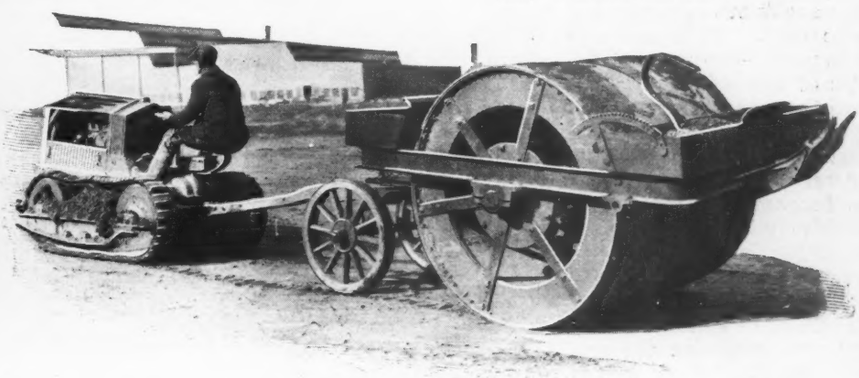


Attaching this apparatus to the back of your Ford turns it quickly and easily into a 3-ton tractor

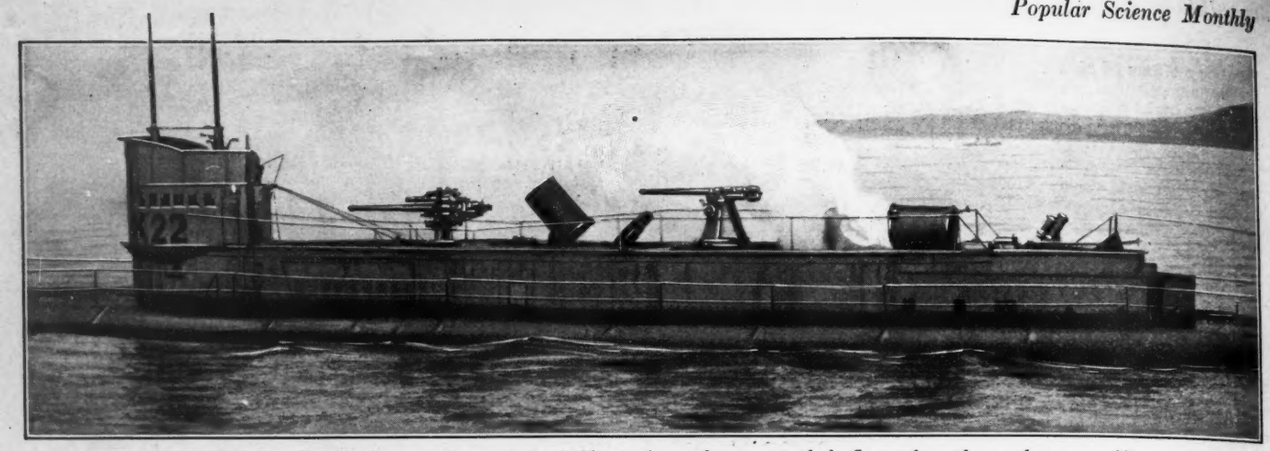


The red fluid flows up the tube directly in your line of vision, warning you that the engine needs your attention; it screws into the radiator cap

Cold? Lift glass windows out of a steel box and slip them into place



The aviation fields in this country are kept in condition by tractors and heavy rollers that keep the ground smooth



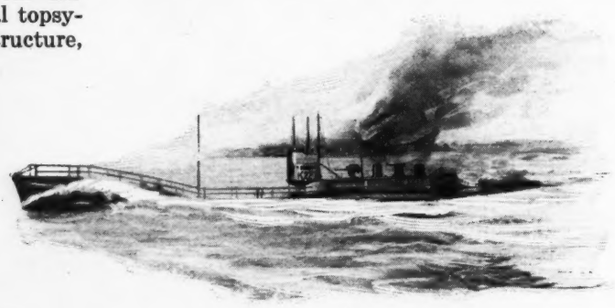
Steam-driven submarines must lower their smokestacks and put out their fires when they submerge. The armament of the K-22 is reported to be two four-inch guns, three anti-aircraft guns, and eight torpedo tubes

Speeding Up the Submarine with Steam

WITH smoke pouring from her after-deck and a general topsy-turvy look about her superstructure, the vessel in the accompanying photographs might be thought to be getting the worst of a lively battle. On the contrary, she has never smelled an enemy's powder. She is a new British type of steam-driven submarine, and the apparent confusion is the result of the order: "Lower stacks and prepare to submerge!"

Not only is the K-22 steam-driven, but she is a giant among her kind, being as large as earlier types of light surface cruisers. She is 340 feet long, and displaces nearly 3,000 tons when in driving trim. Her great superiority over the non-steam types is in her surface speed, which is reported to be twenty-four knots. Once under water, she must rely on storage batteries for her power, the same as any other submarine, and her speed drops to ten knots.

Steam-driven submarines have been the dream of all navies. They have undisputed advantages on the surface.



With a surface speed of twenty-four knots or better, the steam submarine would be as wet on the surface as below were it not for her high bow

Naval constructors have never been satisfied with the Diesel oil-engine. It is heavy and complicated. The problem has been to overcome the disadvantages of steam when diving and in under-water cruising. One of the things sought has been to insulate the boilers so well that they would keep up steam for a long time after the fires were put out, as they must be when the vessel dives.

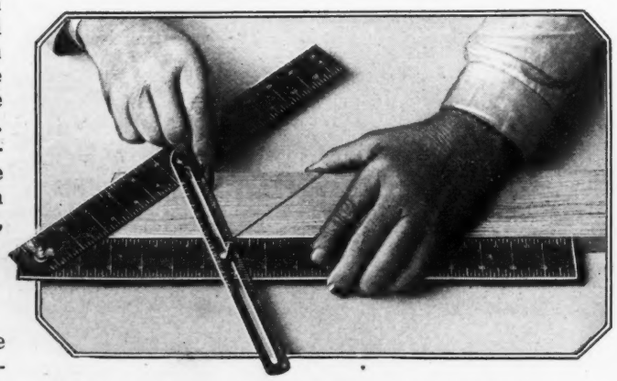
So, when the pictures of the K-22 were released by the British censor, the first question was: "Has England solved the mystery?" Popular Science Monthly put the question to the United States Bureau of Steam Engineering. The Bureau reported that several years ago our own navy experimented with a steam-driven submarine. Like the British boats, it had oil-fired boilers and turbine engines, and on the surface developed the remarkable speed—for a submarine—of twenty-five knots. But the disadvantages were such that the type was abandoned.

To be able to get under water quickly is a life-and-death matter with a submarine. It was found that the steamers lost precious seconds in stowing their smokestacks, which fit into recesses in the decks. The fires had to be put out as the craft took the plunge—otherwise the heat would become unsupportable; and when she came to the surface after a prolonged under-water stay, it took a comparatively long time to get up steam again.

The Square that Bends

HERE is a square that is interested not only in right angles but in obtuse and acute ones. It is made in three parts—two forming the sides of the square, and the third the brace between them. One end of the brace is fastened to the short arm of the square. A groove runs down the brace to its other end, which may be either held fast or left loose by a set-screw in the long arm of the square.

There are two holes in the long arm to receive the set-screw and the brace; one is near the joining of the arms,



Loosen the screw, bend the arms to the required angle, and fasten the set-screw at that point in the groove

the other is the same distance from the joint as in the other end of the brace. When the brace is extended its full length and attached to the outer hole, the square is a true square.

To bend it you need only loosen the screw, bend the arm to the angle desired, and then fasten the set-screw at that point in the groove. One side of the brace is measured off in inches and the other in degrees, as you please.

When the outer bole is used the arms are equal in length, and the resulting triangle is always isosceles and the base angles equal.

Running a Ship with Gas instead of Gasoline

How the producer gas plant adapted to vessels may help to solve the problem of the ever-leaping price of gasoline

By Joseph Brinker

IN England, South America, China, and a few other countries gasoline is extremely scarce and costs one dollar or more a gallon. In the United States the price of gasoline is not quite so high, but it is steadily rising and may reach the dollar mark before very long. Where gasoline is dear and coal plentiful, the installation of a small gas plant for supplying the power for your engine will effect a great saving.

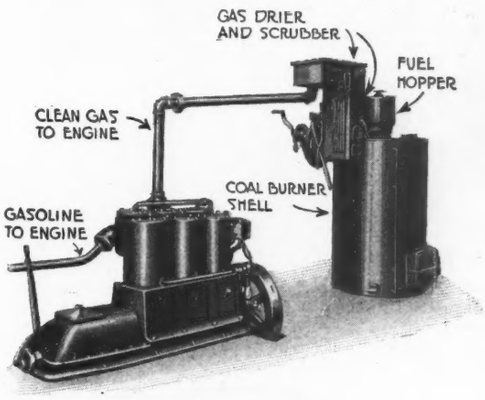
The Producer Gas Plant

The producer gas plant consists of some form of boiler-like furnace in which cheap low grades of coal are burned or distilled with a minimum of air to form a combustible gas, which, after having been cleaned by passing through a checkerwork scrubber, is first dried and then fed to the gas engine.

The gas is ignited and exploded in the cylinder of the engine in a manner similar to that in which the mixture of air and gasoline is exploded in the combustion chamber of a gasoline engine. Pea-size coal, which is cheaper than the coal of larger size, is preferably used in the producer, which has a grate similar to that of other furnaces.

Getting the Plant Ready

When the producer is to be set in operation, a layer of paper is first placed on the grate. The paper is covered with a layer of six or eight inches of charcoal, and that with from two to three feet of pea-size coal. The paper is then ignited and combustion expedited by an air current from a small blower fan provided for that purpose.



The gas plant at the right of the picture generates, purifies, and drives the coal-gas, which is then used direct for running the engine. This plant requires only one third of the cubic space of a steam boiler of the same horsepower

Provision of an underneath water-spray or steam-jet is also necessary. After the fire is burning briskly, more coal is added until the furnace is full.

The suction of the engine draws the gas from the furnace and through the scrubber and drier, which remove the impurities and cool the gas before it reaches the engine cylinders. The supply of gas is thus automatically controlled by the engine itself.

When the engine is stopped, the generation of gas in the producer is stopped. When the engine is running at full power, it is only necessary to add coal to the producer every four or five hours.

The type of producer shown in the accompanying picture is suitable for stationary or marine engines developing from fifty to five hundred horsepower. The fuel consumption is one pound of coal or charcoal for each horsepower-hour. It is claimed that coal or charcoal for the gas producer, at five dollars a ton, is equivalent to steam coal at one dollar and a quarter a ton; to gasoline at two cents a gallon; and to Diesel fuel-oil at three and three quarter cents a gallon.

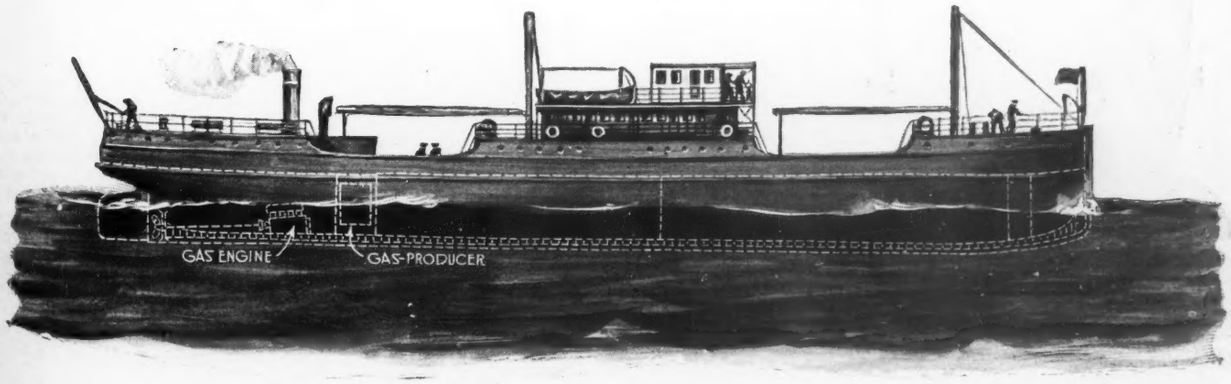
Costs Less and Weighs Less

The gas plant costs less and weighs only one third as much as a Scotch marine boiler of the same horsepower. There is, in addition, very little fire risk and practically no smoke. The coal required to run the gas plant does not take more space than would be needed for gasoline fuel of equal power. One pound of pea coal, which will go into a pint measure, will do the same amount of work as a pint of gasoline.

To Start the Engine

If the engine is large it is first started by gasoline fuel or compressed air. This system gives good results with large or small boats.

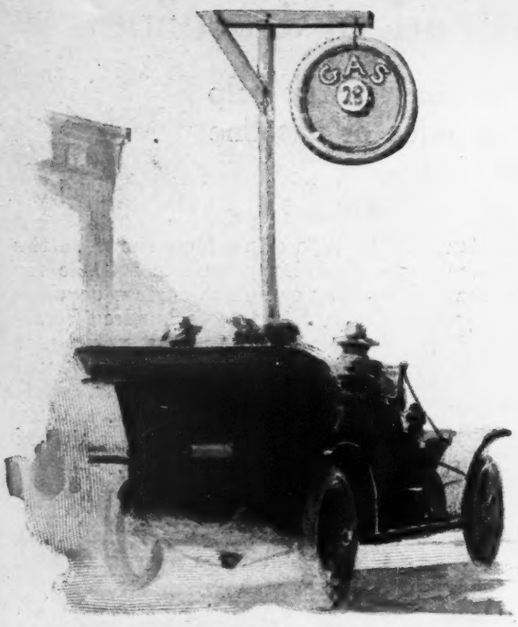
In the large 185-foot boat shown in the picture below, the fuel consumption for a 200-horsepower engine is about four tons for every twenty-four hours in full service, as compared with thirteen tons for a steam engine of the same horsepower.



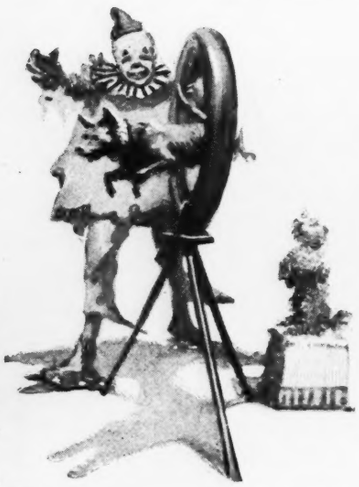
For a 185-foot cargo-boat like the one shown here two producers and two engines of two hundred horsepower each are needed

What You Can Do with

Some further suggestions winnowed

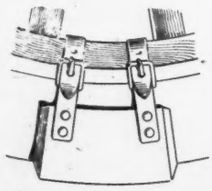


Of course you remember the Old Tire Contest prize-winners in our April issue. Here are some of the "also rans," living monuments to human ingenuity. Our first exhibit is this garage sign
[Submitted by J. J. Otey]

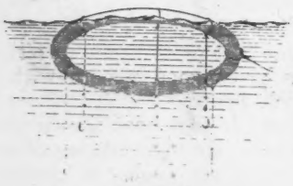


This clown uses worn-out tires instead of the conventional circus hoop
[R. Maginsky]

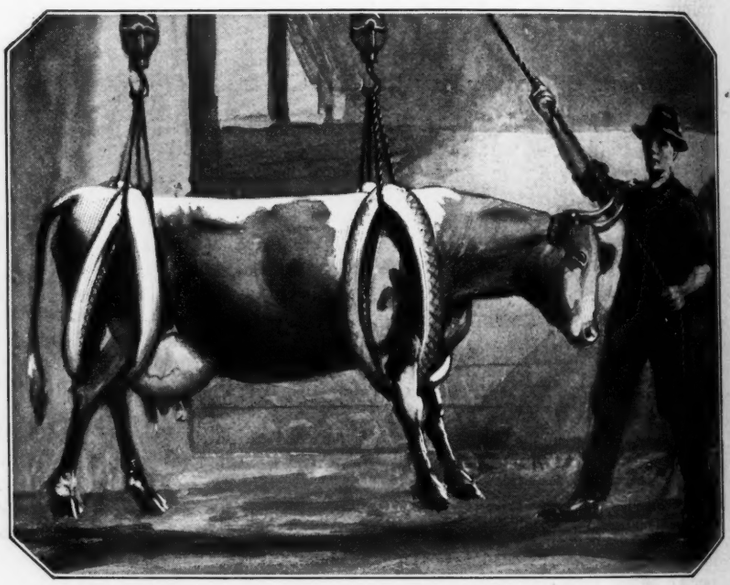
A tire and some wire screening make an efficient ash-sifter
[R. Maginsky]



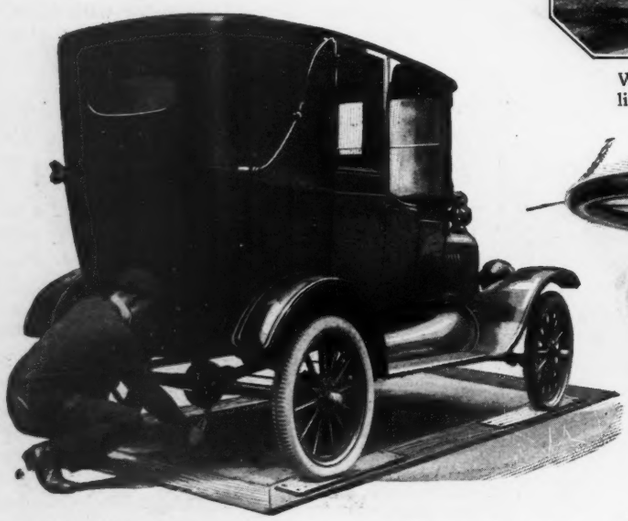
Shoes to protect cuts in tire-casings can be made as shown in the illustration
[C. A. Butterworth]



It beats a "trot line" all hollow. The motion of the tire jiggles the hooks and attracts the fish to the bait
[A. Duffy]

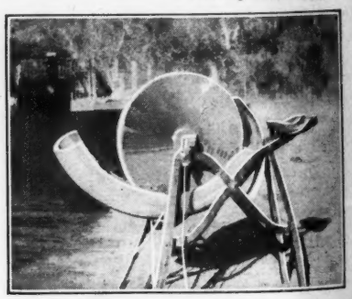


With four tires and two tackle-blocks you can make a sling to lift sick animals to their feet or support them while helpless
[D. E. Johnson]



Make old tires save new by splitting them in half and using them to pad the automobile stand
[James A. Montgomery]

Rigged like this, a tire makes a strong, noiseless punching-bag frame
[R. Glendon]

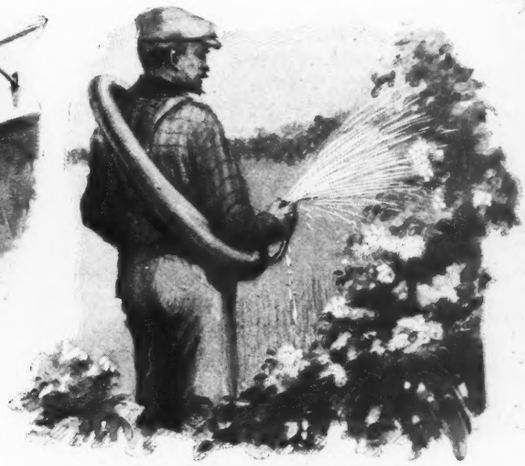


Split open half a tire, hang it under the old grindstone as shown, fill it with water, and you have an automatic stone-wetter that won't rust
[Whitney Asbridge]

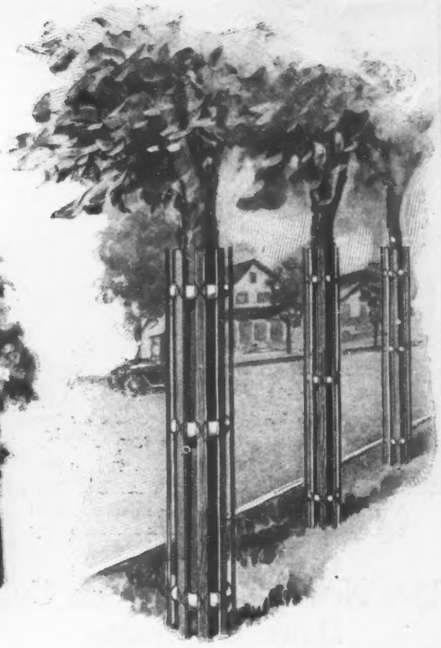
That Old Automobile Tire

from the Popular Science Monthly contest

For basket-ball practice the retired tire makes an improvised basket. The supports should be one foot long
[R. Maginsky]



Hitch up an inner tube like this and be your own hose-cart. To fill, slip the hose over a faucet and press the valve
[C. A. Black, Jr.]

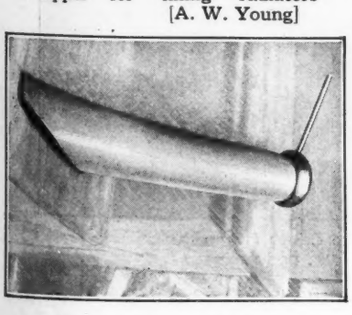


Cut to proper lengths, old tires make excellent tree guards. Sew the cut ends together with waxed thread
[C. L. Meller]

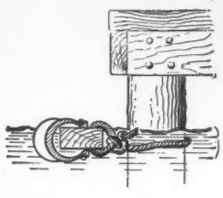
Having done their duty ashore, send 'em to sea. Cut into uniform sizes, laced and hung as illustrated, they make efficient buffers
[W. E. Wylam]

Some day he'll make 'em go round—now they go round him. Properly spaced, with the spokes terminating in free-moving casters, two old tires will make baby a novel walking-chair
[R. Maginsky]

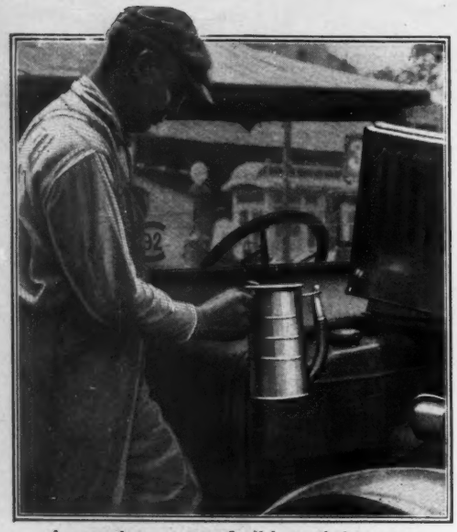
Cut one end of an inner tube as shown, join edges, bend a rod around one end for a handle, and there's a handy dipper for filling radiators
[A. W. Young]



Two ways of turning old tires into dock bumpers. If rigged on a float they will be effective on all tides
[C. A. Butterworth]



Shock-absorbers helped these tires to a ripe old age; now they are shock-absorbers for the eggs
[Thomas E. White]

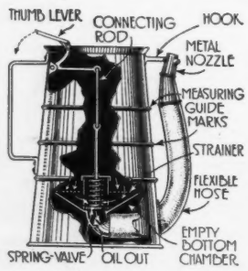


A conscious waste of oil is a misdemeanor; the oil-can above does much for economy

This New Measuring-Can Cuts Down Oil Waste

IF the new type of measuring-can illustrated above and in cross-section were in common use much waste would be avoided. The measure combines a funnel and strainer. The filling operation can easily be performed by one hand.

A flexible nozzle hose is provided to reach unhandy filler caps. The oil is fed through the nozzle by means of a small valve in the bottom of the tank, the opening and closing of the valve being regulated by a small thumb lever near the top of the can.



The oil flow is controlled by a valve operated by pressure of the thumb

Before pouring out of the can, the oil has to pass through a strainer placed horizontally around the valve chamber. Grooves in the outside of the can serve as quart-measure marks for fractional amounts.

Easier Riding for the Farm Tractor

MOST people think that the springs of an automobile are simply for the comfort of the passengers. They are wrong. The springs also cushion the driving mechanism, the engine, clutch, gear-set, driving shaft, and axle, from shocks.

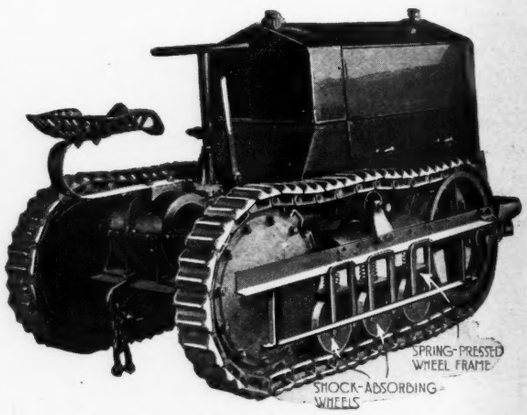
In farm tractors, especially in the earlier types, springs have been considered rather a superfluity. So, when the modern automobile type of gasoline engine was employed in farm tractors, it was necessary to cushion it from the sudden shocks of uneven ground. The rough going made up for the lower speed of the tractor as compared with the passenger car.

Finally the engine and the rest of the tractor power plant was mounted on a separate frame pivoted to the tractor frame at one end, so that the latter could twist in going over rough ground without twisting the engine frame.

But some shocks and strains were still transmitted to the engine frame, and Rollin H. White, of Cleveland, Ohio, set out to improve the method of mounting by a special system of springs in which there is less relative motion between the two frames and in which a greater length of the ground reach of the track-layer is in contact with the uneven surfaces of the ground over which it is traveling.

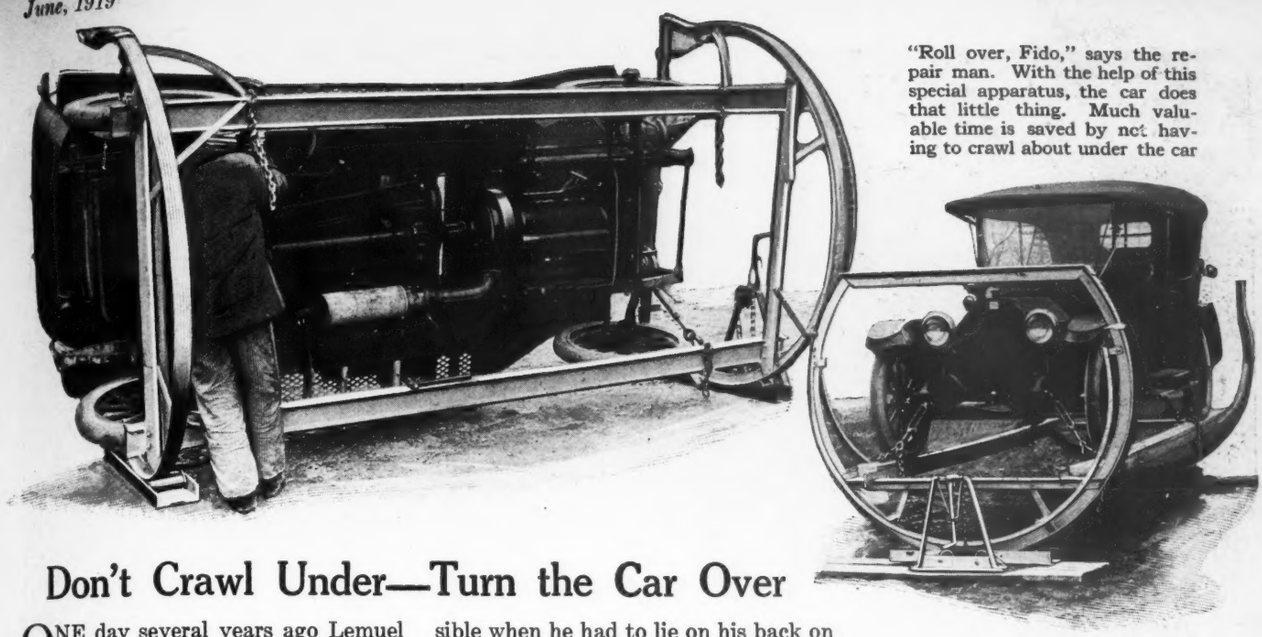
The tractor frame is pivoted to the main engine frame at the rear as usual, but is made up of two built-up beams. These are formed of top and bottom horizontal beams connected by lattice bars in two parallel units joined by a yoke at their front end. The yoked ends serve to support a transverse leaf spring carrying the front end of the engine front.

Three wheels mounted inside the built-up frame roll on the upper surface of the flexible track-layer. Each wheel is held in a bearing in a small vertical plate made to slide up and down against the action of a coil spring inside of an inverted U-shape that can slide inside the built-up beam. The coil spring tends to force the wheel against the track-layer and keep the latter in contact with the ground.



Each wheel slides up and down against the action of a coil spring which acts as a cushion

Bumping the bumps is made much easier for the tractor, and incidentally for the driver, by an adaptation of coil springs that prevents the shocks being transmitted to the driving gear and engine



"Roll over, Fido," says the repair man. With the help of this special apparatus, the car does that little thing. Much valuable time is saved by not having to crawl about under the car

Don't Crawl Under—Turn the Car Over

ONE day several years ago Lemuel C. Nicoson, of Alexandria, Indiana, got a drop of oil in his eye while working under an automobile. This set him thinking.

Action followed thought, and he has now worked up the device shown in the two accompanying illustrations. With it the car may be turned completely over on its side, or to any angle up to ninety degrees from horizontal. This permits the workman to examine and repair any part of the running gear while he is standing in an upright position. He can do several times more work than was possible when he had to lie on his back on a greasy floor and move himself backwards and forwards on his hands.

The "turn-auto," as it is called, will accommodate any size, width, length, or weight of automobile. The device is simply constructed and will not get out of order. A small boy can turn the car over and back.

The apparatus consists of two partly circular angle-iron end members set up vertically and joined by two horizontal I-beams which serve as the tracks on which the car is run from the ground by means of short skids. Once on these tracks the front and rear axles are made fast to the tracks by means of chains.

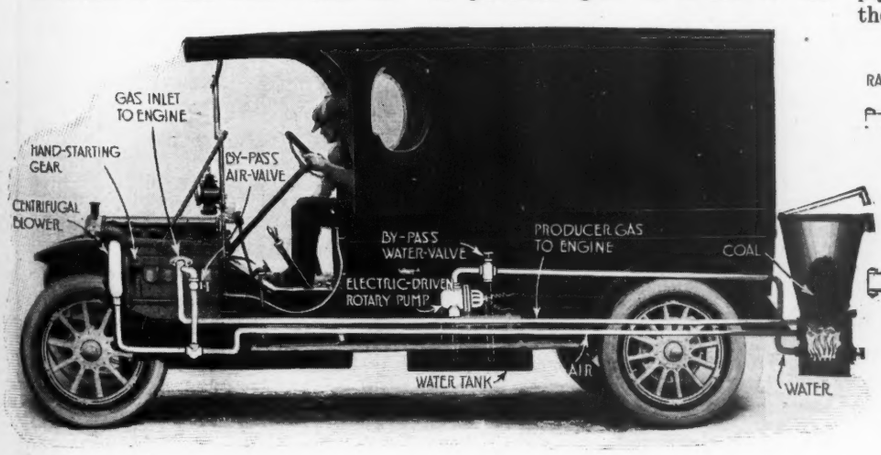
Each partly circular end member is set up on a flat base support which serves as a platform on which the end member can be revolved by means of a small chain and sprocket turned by a handle at one end. To turn the car on its side, the handle is turned to revolve the end members, and with them the car, to any desired angle. The car is brought back to its normal position by turning the handle in the reverse direction.

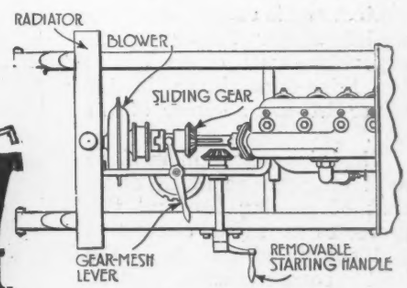
Motor-Trucks that Make the Gas they Burn

TWO British inventors, William Parker and G. Goldsmid-Abrahams, have designed a motor-truck the engine of which is run by producer gas. The gas plant consists of a small furnace with a funnel-shaped top filled with pea-sized coal. The coal is burned under a strong draft produced by a blower.

A stream of water from a tank underneath the truck is forced by a small rotary pump into the combustion chamber of the furnace in the form of a fine spray. Through the heat of combustion, which causes a splitting up of the water into its component elements, hydrogen and oxygen, the coal is distilled to form coal-gas. This gas, enriched by the hydrogen, is known as producer gas. It is fed to the gas engine of the truck, the greater part of the oxygen combining with part of the carbon to maintain combustion.

To start the truck, the blower is set in motion by a hand crank or a small motor, which, when not operating the blower, may serve as a generator for charging a storage battery for supplying electricity for the ignition and the lights.





The truck at the left is driven by an engine fed by gas instead of gasoline and shown above. The gas is generated in a small gas plant attached to the rear end of the truck

No round shoulders or curved spine for the boy who rests his book on the desk-top in the picture above

As the Desk Is Bent the Boy's Inclined

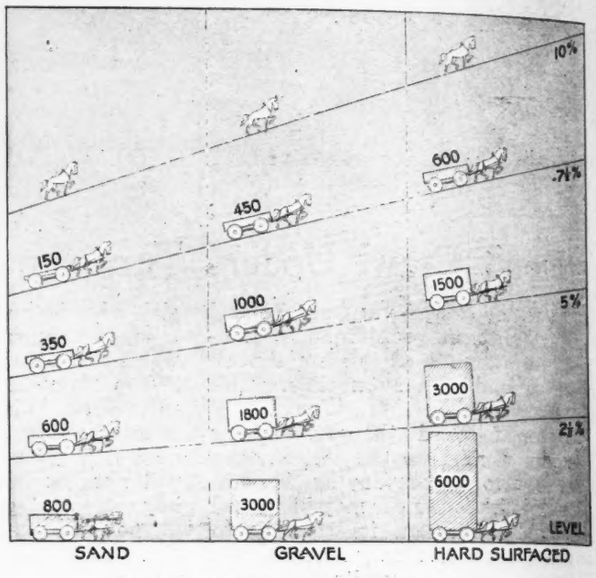
A CITIZEN of Seattle, Mr. John O. Foster, has been disturbed because of the flat-topped desks used in schools. He says they cause curved spines and eye-strain. He has invented a desk with an adjustable top.

The desk is adjusted by means of a bar on its under surface. This bar has a grooved slot in its other end, through which a bolt passes. One end of the bolt is fastened to the desk, the other terminates in a wheel. This wheel regulates the bar, which is pressed between the desk and a metal ring.

It All Depends on the Road

HOW much can a 1,200-pound horse pull? It all depends on the road.

The United States Office of Public Roads and Rural Engineer has figured it out. On a hard-surfaced road the horse can pull 6,000 pounds on the level and 600 on a 7½ per cent grade; on a gravel road his pulling powers run from 3,000 pounds on the level down to 450 pounds at the 7½ per cent grade; while in sand the horse can pull only 800 pounds on the level and can just tug 150 pounds at the steepest grade.



Showing how good roads, up hill or down, add to the pulling power of the horse

How Would You Like to Be the Iceman?

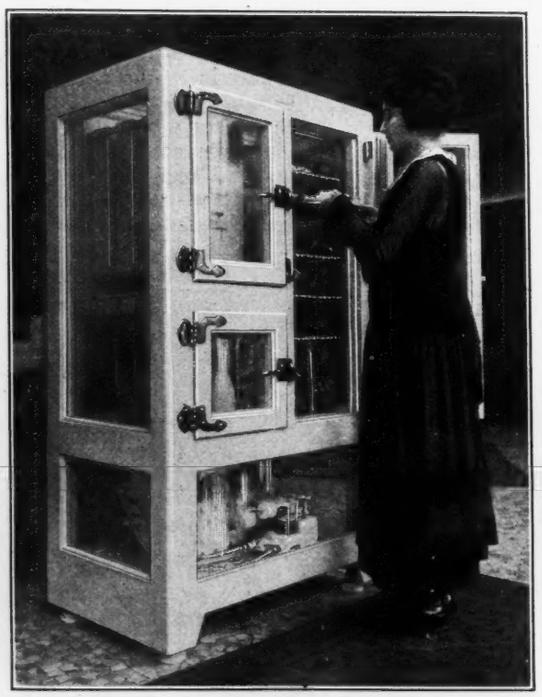
BE your own iceman! That does not mean that you should go forth with a pair of tongs and bring back a dribbling piece of ice; it means there has recently been invented a small automatic cold-storage plant which will fit in your kitchen. It refrigerates without ice, making ice from ordinary drinking water. It can make one hundred and fifty cubes of ice a day.

The operating principle of this machine is similar to that of the large refrigerating plants. The entire machine assembly is located in the base of the cabinet and is connected by annealed copper tubing to the expansion coils concealed in the brine-tank shown in the upper left-hand corner of the box.

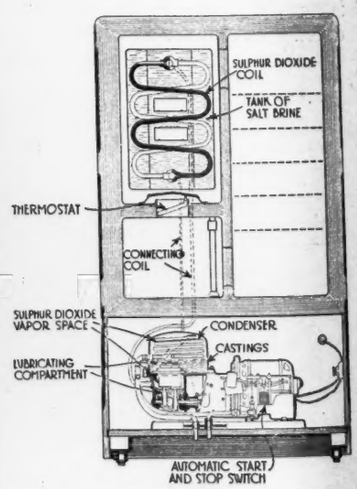
The brine-tank is maintained at a temperature much below that of melting ice, and this promotes a rapid circulation and cooling of the air in the food compartments. The brine-tank never requires any attention.

As it would be wasteful to throw away the gas after it has done its work, a pump is used in the base chamber to suck the gas down through a copper tube and compress it into the condenser, where it again changes into a liquid. Thus the liquid (sulphur dioxide) is used over and over again without loss, being made to circulate by the small pump in the base.

The specially designed two-cylinder piston pump is driven by an electric motor.



This ice-making refrigerator does away with the iceman and the unsanitary drip-pan



The interior of the plant, showing the refrigerating apparatus in detail

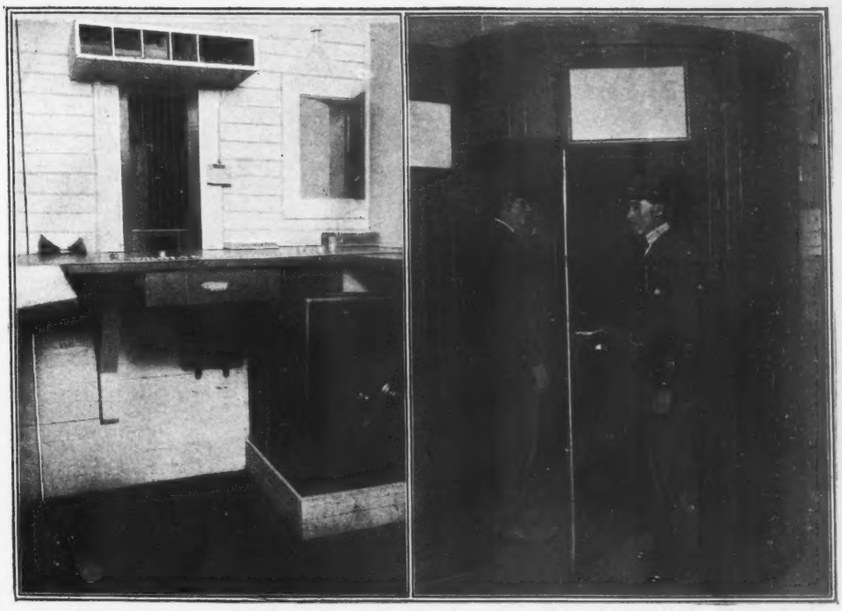
Finding How Hard a Spring Will Spring

THE resistance given to different springs varies according to their intended use. But when springs are used together, their resistance must be the same.

In the box in the picture are springs that have just been made and that are supposed to have the same resistance. How can this be proved? By means of a testing-machine. The tester places the spring on the platform of a scale and then presses down on a handle to which a vertical bar is attached.

The bar compresses the spring as far as possible, and the scale shows the number of pounds pressure.

The tester presses on a handle which compresses the spring, and reads the result on the scale

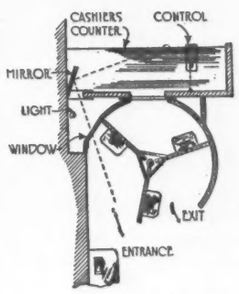


A lever at the cashier's foot controls the door through which all visitors enter

A Trap for the Hold-Up Man

HOLD-UP men like to do business at the window of the railroad cashier, where at each day's close the conductors dump small fortunes out of their pockets.

A trolley line in Duluth which valued its hard earned nickels has discouraged this hold-up habit by building a trap outside of the cashier's window. To reach the window conductors and hold-up men must walk into a three-section revolving door which is controlled by the cashier.



By means of a mirror the cashier sees who is coming in before he gets there; and forewarned is forearmed

When the door has made a one-third revolution it locks automatically and will not move until the cashier presses a pedal. If he admits a two-gun man, he may hand over his cash, but the bad man can't get away with it until the pedal is pressed.

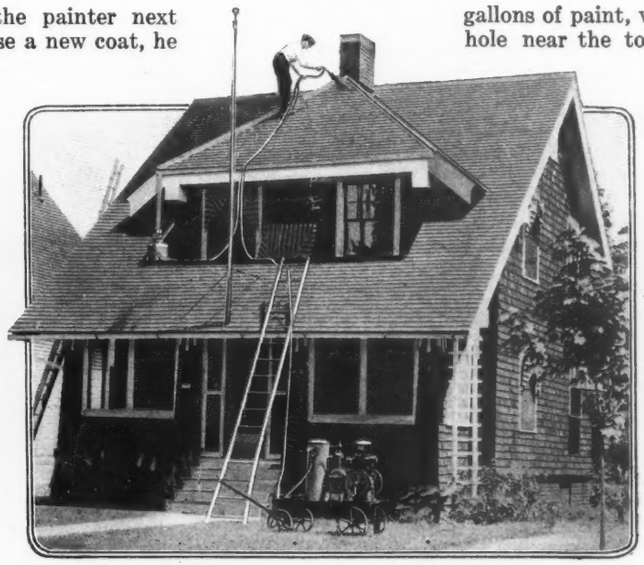
He Sprays the Paint on through a Hose

WHEN you send for the painter next spring to give your house a new coat, he may run up the path pulling behind him a boy's express wagon with a neat machine on board, and tell you he is ready to start—no sticky brushes, no sloppy paint-cans, no scaffolds, rags, or other dirty things that painters bring.

The machine on his cart is a paint spray. All that the painter has to do is direct the hose, to make an even coat of paint on the building.

Besides yards of hose, the machine consists of a small gasoline engine to furnish power, an air-compressor, and the can from which the hose gets its paint.

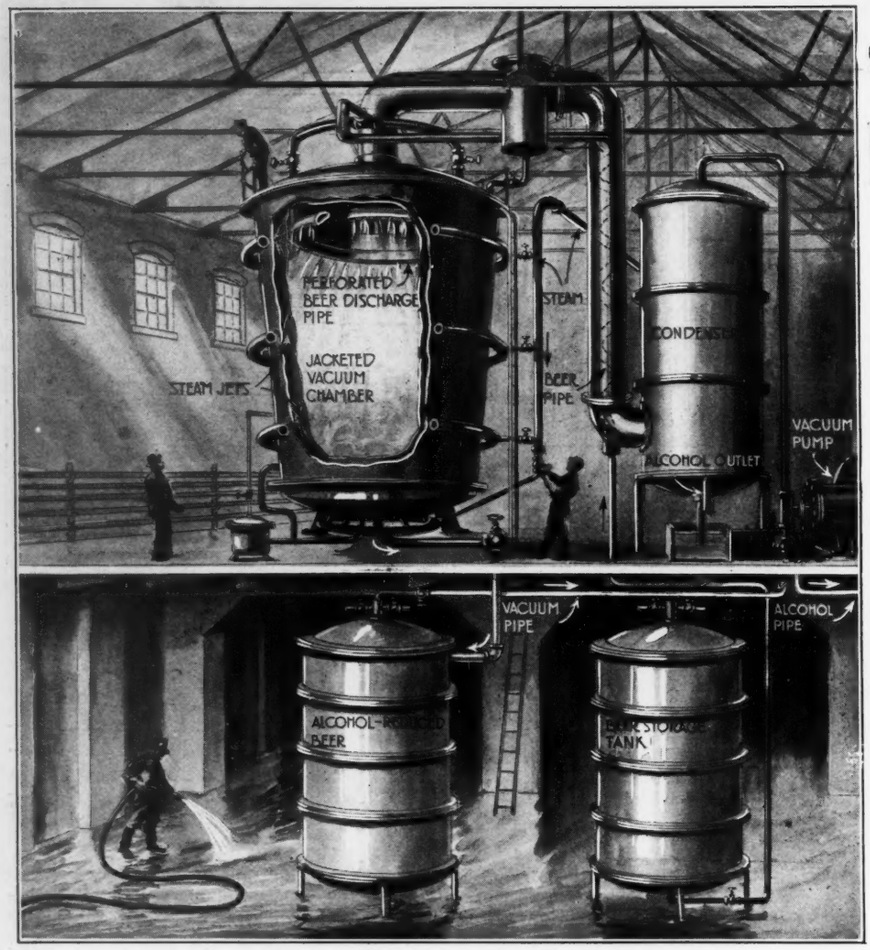
The tank holds seven gallons of paint, which enters through a small hole near the top. There is a faucet underneath to let it out if necessary. Gages and safety-valves decorate the top, so that no accidents will happen.



With the hose he sprays the house with paint pumped up from the machine on the little wagon below

The neatness of this machine is not its only asset. Sprayed paint gives a more even finish than paint applied by hand; an extension pole takes the place of scaffolds; no paint is wasted; and it is claimed that by the new method the work can be done in about one fifth the time hand-painting takes.

Of course, if the painter should be careless, he might very easily paint your trees, lawns, and window-panes an unbecoming color.



A steam-heated container, or vacuum chamber, in which alcohol in beverages is reduced by being boiled away or evaporated

Taking the Kick Out of Beer

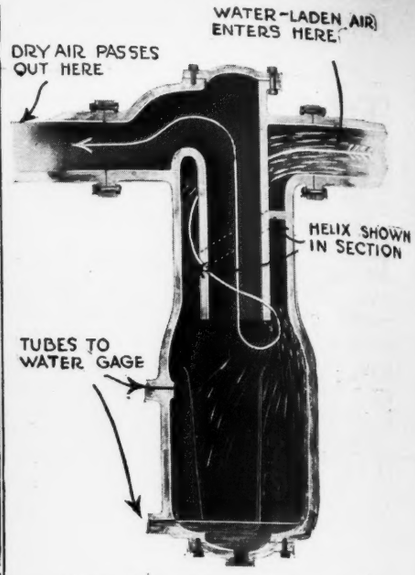
EVERY brewer in the United States will soon have to either shut up shop or adapt his plant to changed conditions. Divers opinions are held and sundry policies followed by the brewers regarding the future.

Some of the brewers have already made radical changes, turning the costly equipment of their plants to work on new, unfamiliar, yet profitable products; others are preparing to quit business of any kind; a few believe that future legislation will permit them to brew two per cent beer, and they are relying on the ingenuity of the expert industrial chemist to discover a way to save machinery that cost the brewer millions of dollars from going to the scrap-heap.

The manufacture of wholesome soft drinks or of spirituous beverages with the alcoholic kick taken from them seems to be one way out of the situation. A new and improved process for removing or reducing the alcohol in any kind of alcoholic beverage, especially beer, has been invented by Herman Heuser, of Chicago.

Broadly speaking, this process consists of continuously flowing the beverage in a thin sheet or film over the vertical or inclined zone of an evaporator, preferably a vacuum pan, all the while subjecting the liquor to intense latent heat of steam between the walls or shells of the container. By this means the beer is boiled momentarily and its alcoholic content is instantaneously reduced.

In the case of beer, in prior processes, prolonged boiling at high temperatures results in a brew which, though safely dealcoholized, has a distinctly unpleasant taste and odor. By the Heuser process, it is claimed, the original quality and characteristics of the beverage—such as taste, odor, and foaminess—are retained, owing to the quickness of exposure to the boiling action.



When the water-laden air rushes through the helical channel, centrifugal force separates the water from the air

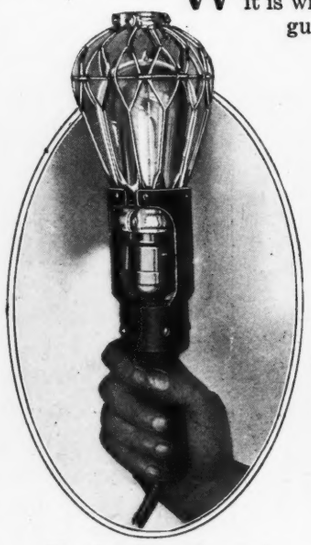
Whirling the Water from Compressed Air

AIR invariably contains water in the form of vapor. When air is compressed, the percentage of water increases with the pressure. The presence of water in the air is often highly undesirable. To remove it the air is cooled to the point of condensation and then forced through the separator shown above.

The water-laden air is forced through a helical channel, whereby it is given a rotary motion. The water is separated from the air by centrifugal force and collected in a tank.

It Protects Electric Lights

WHEN you work in dark places, it is wise to carry a wire lamp-guard with a wooden handle, which can be snapped around any light. Such a lamp is shown in action here. Both handle and guard are split in halves and hinged only at the end of the guard.



The handle and guard are made in halves, so that they can be put on or taken off any light

In using the device, close it over a bulb and lock it in place. The extension cord leading from the bulb fits in a socket in the handle halves. This eliminates the usual trouble of wiring a handle guard.

A hook can be attached to the end of the guard for hanging it up, leaving both hands free.

Can You Run Your Automobile by Sun-Power?

Not quite yet, but some day you may be able to hitch up the sun and say "Giddap!"

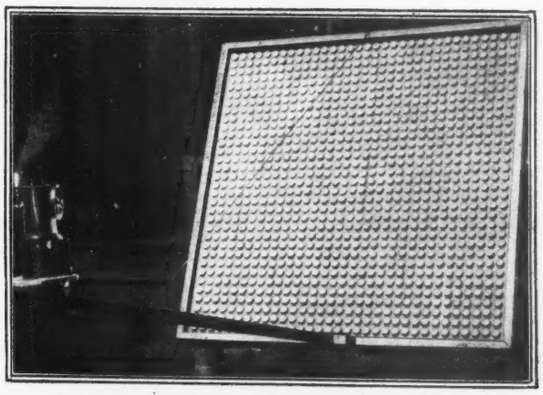
By A. J. Lorraine

FIVE thousand horsepower going to waste on every acre of land! If you were told that oil had just been discovered on your property you would instantly be wide awake to the new financial prospect before you. But you allow a golden flood to pour down on the earth all around you without paying any attention to it. For in sunlight there is power, power enough to drive a sea-going vessel by the rays that fall on its deck—if only we knew how to harness this power in our service.

When All Our Coal Is Gone

Of course, in one sense, that is exactly what we do when we burn coal under the boilers of our steam-engines. For coal is fossil vegetation, plants that grew ages ago in the sunshine of the far geological past. But in burning coal we are living on our capital, for we are consuming the black diamond incomparably faster than it was formed and the supply is constantly diminishing. The day is coming, and is probably not so very far off, when the world's coal-mines will be exhausted. What are we going to do then?

Vast amounts of coal are needed, not only for fuel and light in our houses, offices, and factories, but as the ultimate source of power in the great majority of steam- and gas-engines. Further, immense quantities are consumed to reduce iron and other metals from their ores. Even if we had no cause for anxiety regarding the supply, we might yet reasonably ask: Why this round-about method of getting energy out of sunlight? Why wait for geological ages until plants have leisurely grown, died, and become fossil? Is there not necessarily much waste in such an indirect process? What about all the sunshine that strikes the bare earth or the roofs of our houses, sunshine that never comes near the green leaf of a plant? If plants know how to collect this sunlight by means of their green leaves and to utilize it, why can not we do the same?

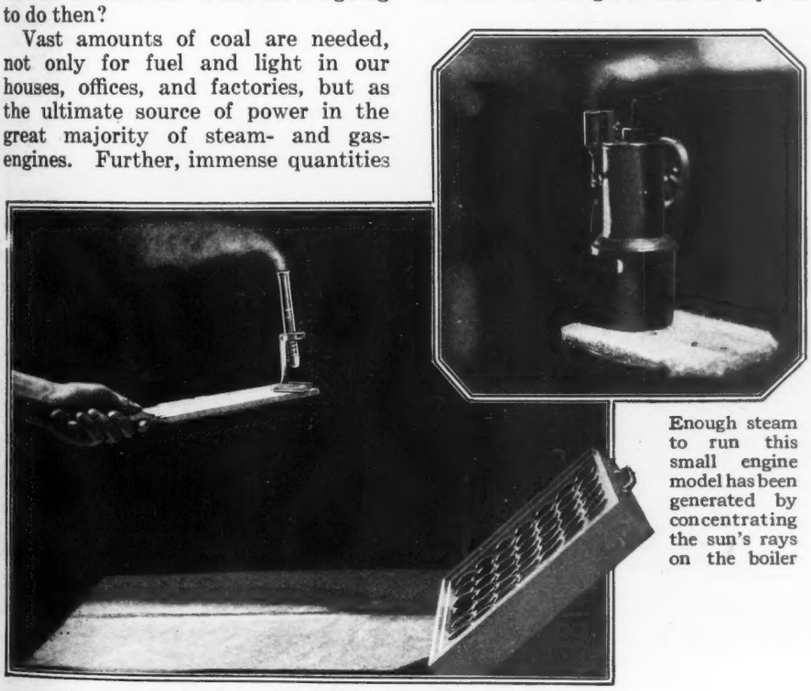


This reflector, with fifty mirrors to a square foot, will melt a bar of lead 1½ inches thick in 43 seconds

The fact is, we are here confronted with one of the great outstanding problems of technical science, a problem of such importance that its solution will be a historical event ranking in magnitude with the invention of the steam-engine, the telegraph, the telephone, wireless telegraphy, and aerial flight.

A Sun-Power Plant

It is not that efforts in the right direction have been wanting. Some of them have even been quite promising in their results. But it is not enough to obtain power from sunlight: this result must be achieved with a margin of profit in competition with the old established ways and means of drawing energy from coal. If all we want is to demonstrate the physical possibility of converting sunlight into heat and work, we can do this very easily on a small scale by concentrating the rays of the sun with a lens on the boiler of a small steam-engine. For large-scale work this arrangement is impracticable, though various modifications of it have been tried with reasonable approach to success. A sun-power plant, which used a system of mirrors in place of a lens, was operated for a time in Egypt; but it had to be abandoned as, at best, only a partial success.



The water in this test-tube is boiling as the result of focusing the sunlight upon it from a system of reflectors

Enough steam to run this small engine model has been generated by concentrating the sun's rays on the boiler

Running an Engine by Sun-Rays

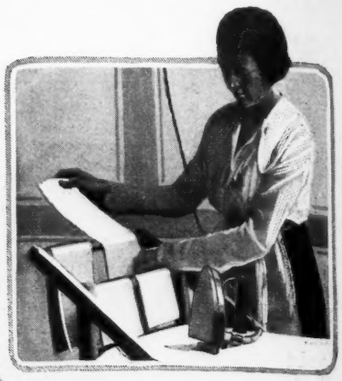
From Toronto, Canada, comes the report of a new development. Dr. W. J. Harvey has constructed a compound reflector in which some forty or fifty individual mirrors are arranged in a frame one foot square, or a proportionately larger number of mirrors for a larger apparatus. It is claimed that with this reflector a bar of lead 1½ inches thick has been melted in 43 seconds. A small steam-engine can, by its means, be run on sun-energy.

It remains to be seen how Dr. Harvey's reflector stands up under the more severe trial of operation in conditions corresponding to technical practice. The day when you will run your automobile on sunshine is, we fear, yet a long way off.

Housekeeping Made Easy

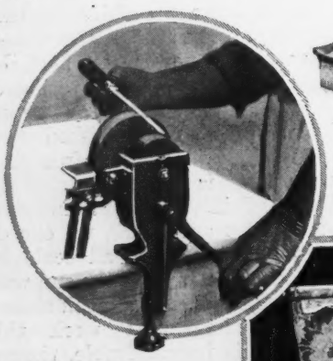
Machines that lighten work and keep the housewife happy

With this arrangement you don't have to worry about the plants dying of thirst while you are away on a visit. A wet sponge inside the covering feeds pieces of felt, which in turn pass on the moisture to the plant in small and well regulated amounts

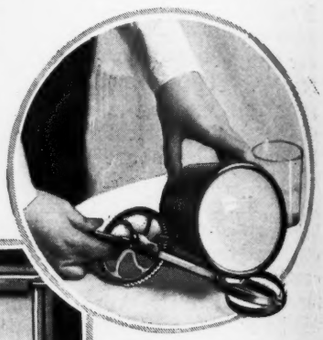


It is no longer necessary to have a "clothes-horse" encumbering the laundry when small linen pieces are being ironed. This ironing-board has wooden bars attached at one end to hold the linen after it is ironed, thus saving many steps

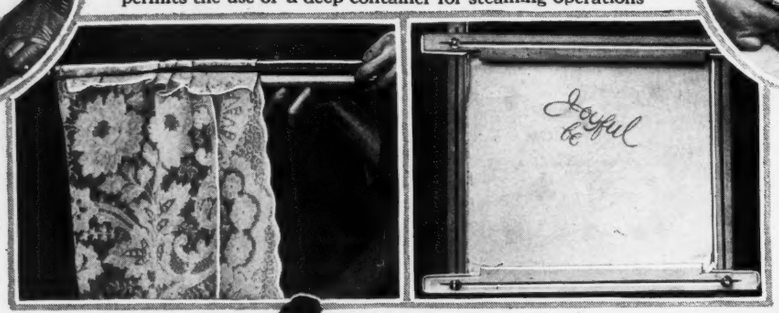
Clamping preserve jars one above the other with this device permits the use of a deep container for steaming operations



With this little rotary grinder in your kitchen there is no excuse for dull knives



This bowl is weighted at the bottom to keep it steady when beating cream



A pinless curtain-holder that makes curtains hang both evenly and gracefully

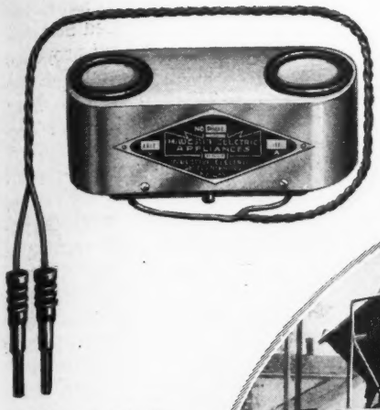
By holding the embroidery cloth taut, this pinless frame facilitates work

An unexpected guest? In two seconds you can turn this chair into a bed and ask him to stay all night

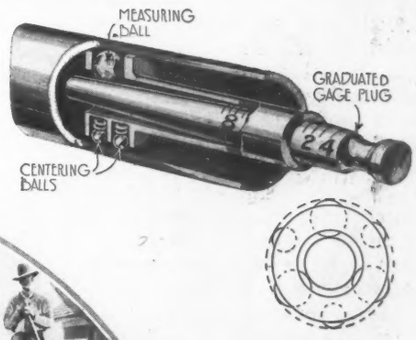
This combination bath-chair and boot-blacking outfit is hard to beat

Do It with Tools and Machines

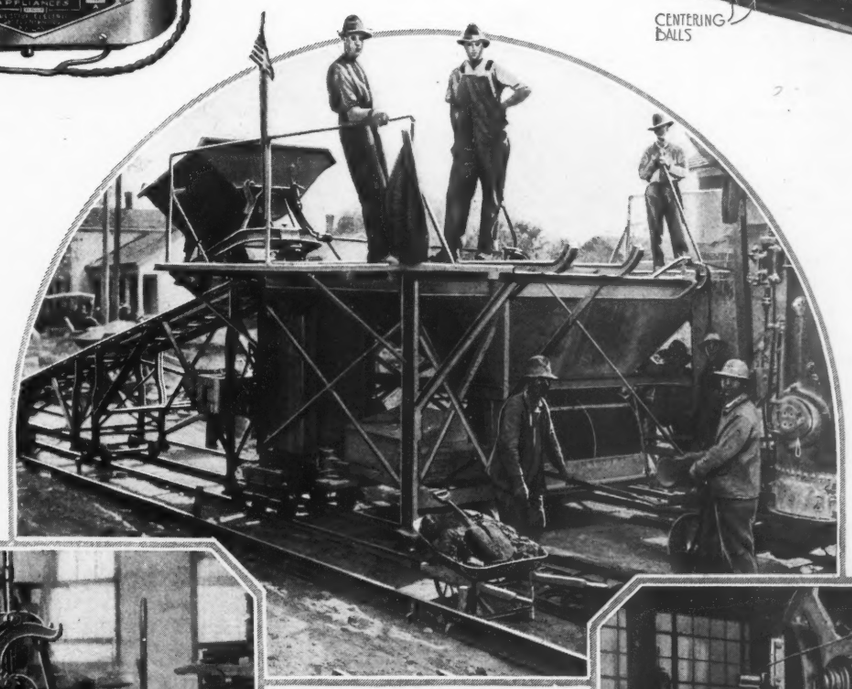
Some new tools that minimize labor in shops



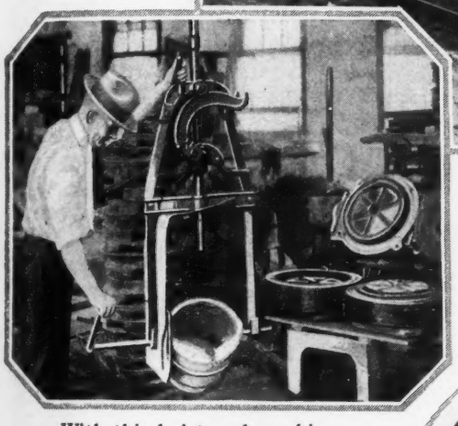
"Feeling the juice" (to determine between direct or alternating current) is made safe by this determinator



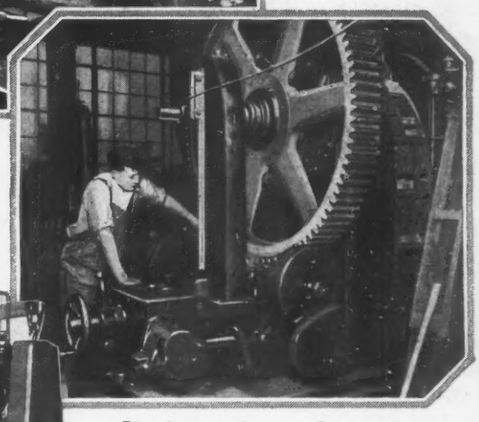
Faulty parts and internal balls of machinery may be detected by the recently invented gage shown above



The unappeasable appetite of this many-functioned concrete-mixer keeps a locomotive busy hauling its food to the place of action

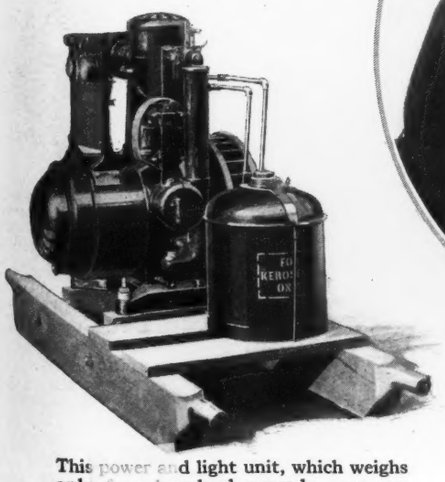


With this hoist and machine one man can pour molten metal

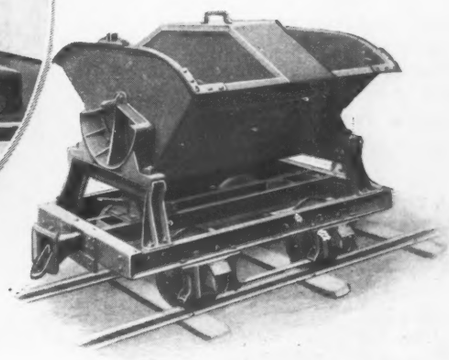


It takes nearly a week to cut one hundred teeth in this gigantic gear

Many thousands of tests of the tensile-shear strength of plywood for aeroplane fuselages were made for the government by this woman



This power and light unit, which weighs only four hundred pounds, can use either gasoline, kerosene, crude oil, or gas



Measuring correct amounts for concrete mixtures, this car has special compartments for weighing bulk or bag cement

Scorching the Water with a Model Racer

THIRTY-FIVE miles an hour is the remarkable speed which the *Elmara II*, an American model power-boat of the seaplane type, achieved recently in an unofficial test at New York. The racer is only a trifle more than thirty-nine inches long and 7⅞ inches beam, is built of aluminum and mahogany, and is driven by one of the newest flash-system engines using superheated steam for its power.

Model power-boating has been a favorite sport in England for some time, but has been taken up in America only recently. The speed record in England is held by the *Evil Spirit*, which made twenty-six miles an hour. Even at the conservative estimate of thirty miles an hour, the *Elmara II* would be an easy winner in a contest with the *Evil Spirit*. The builder of the *Elmara II*, who is an enthusiastic model power-boat racer living in New York, has already made arrangements to enter his boat for the next international model boat race to be held in England in the near future.

It requires great skill and a delicate touch to adjust the engine and valves of one of these model power racers

Sixteen miles an hour has been the greatest speed attained by a model power-boat propelled by an internal combustion engine. Storage batteries have been tried, but with little success.

Nearly all fast model power-boats are propelled by either gasoline or steam engines operating on the flash principle. As it is next to impossible to make model racers pursue a straight course, they are generally run over a circular course around a center stake, to which the boat is fastened by a string or wire.

The speed of the boat is calculated from the known circumference of the circle around which it moves. A circle with a circumference of three hundred feet is generally used in speed tests.

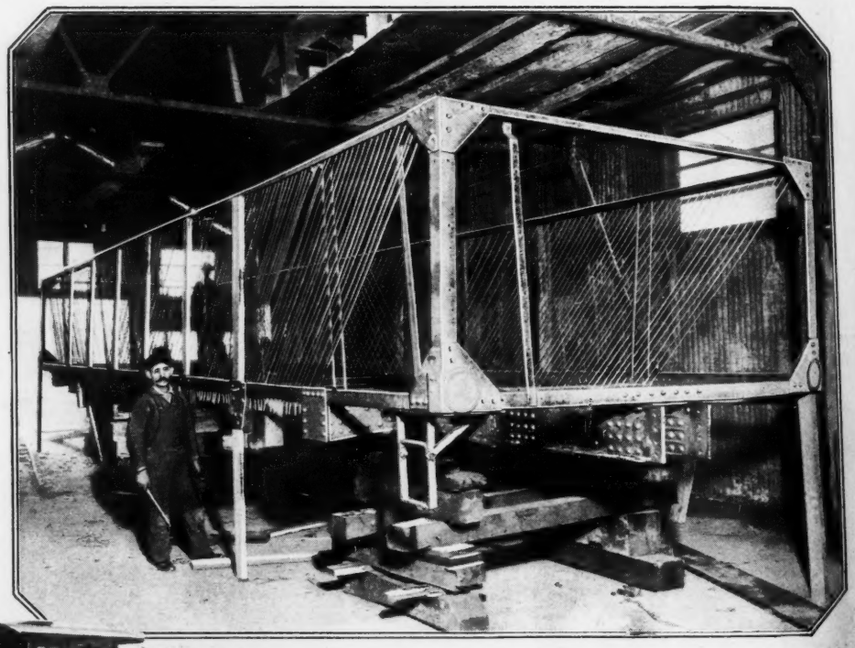
The adjustment of the engine of one of these model racers is extremely difficult, and requires considerable skill and patience. After the boat has started on its course it is impossible to make any changes in the adjustment.

Modern Freight-Cars Are Made of Cement

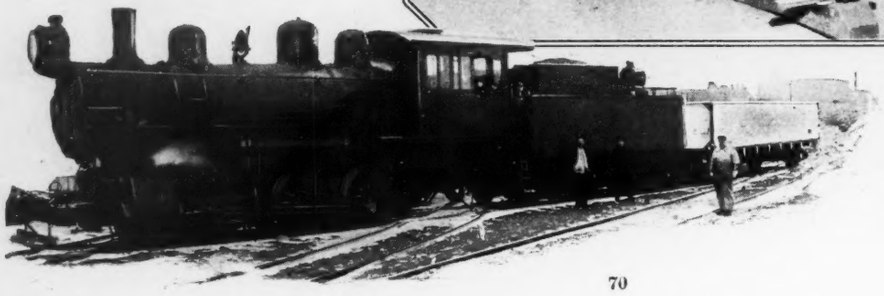
"TERRIBLE railroad wreck! Wooden cars crumble and then catch fire! 200 killed!" That is the tale of the wooden railway car, and that tale has spelled its doom. Passenger-cars are now steel-made. But how about freight-cars? Must they continue to crumble and catch fire because of their woodenness? Not if concrete freight-cars prove successful, and the chances are that they will.

A concrete car is more easily made than a wooden one; it costs less, lasts longer, needs no painting and repairing.

The steel frame for the walls, floor, and base are made first. Then forms are placed outside the frame, and men go inside with cement-guns and start shooting. The outside of the car thus gets a smooth finish.



In building a cement freight-car, the steel framework is erected first: then forms are placed outside it and the cement is shot at the framework from within

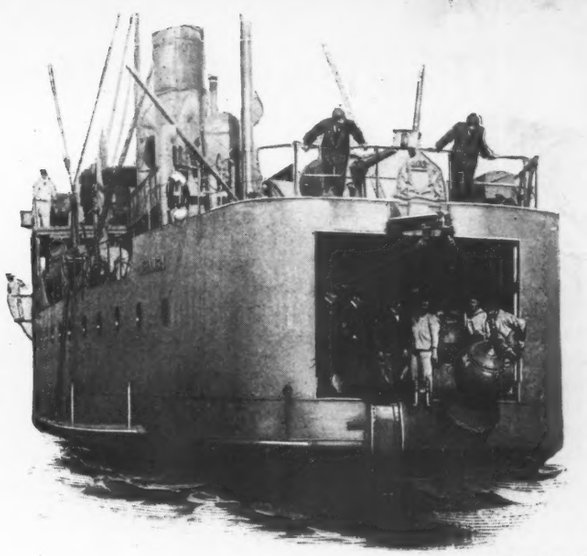


To test the car, it was first overloaded and then switched rapidly from track to track. It came through totally unharmed

They Are Still at War

Two million deadly foes do not know peace has come

IN the North Atlantic and in the narrow waters of the North Sea are hundreds of thousands of the deadliest foes who do not know that peace has been declared. They are the great army of mines, estimated at two million, planted by the formerly warring nations. Each one of these mines carries the power to destroy the greatest ship. To hunt them down and rid the seas of them is, perhaps, a more courage-trying job than any the fighting men faced during the great war.



Hoisting in large packages of sudden death is the regular work on the mine-sweepers that are making the seas safe for commerce

© Press Illustrating Service

What the Mines Are Loaded With

The cost of these mines in money was tremendous—something like an average of $1,000 for each of the two million. The cost in lives cannot be reckoned until the last is swept from the seas. It is a job which, as one of the world's greatest experts on submarine mines told the writer recently, "can never be prosecuted safely." It will be done by mine-sweepers such as the one shown in the accompanying photographs. Hundreds of these mine-sweepers, equipped with the most approved apparatus for grappling and raising mines, are manned by thousands of men to whom a sudden trip skyward would be all in the day's work.

T.N.T., an average of 200 pounds of it to each one, is what the mines are mostly loaded with, which means that there is a total of about 25,000 tons of this terrific explosive to be harvested. And harvested it will be; for this undertaking is not a matter of destroying the mines, but of salvaging as many of them as possible. The explosives planted to kill are also useful in the peace-time arts that help men live; and then—well, the nations have not disarmed yet.

Some of the mines will be cured of their bite by time—those that depend upon fulminate of mercury or similar detonating compounds to set them off when a ship strikes them deteriorating quite rapidly and becoming unreliable as death-dealers in about six months. But there are great numbers of later types so improved as to keep alive no one knows just how long.

As long ago as the Russo-Japanese war, when submarine mines had not been so perfected as to give them the long life of those afloat today, for a long time after hostilities had stopped, ships were sunk by mines drifting about the Pacific. Fortunately, the trend of the currents in the North Sea, where the vast mine-fields were placed, is such that the danger of large numbers of mines getting into the main steamship lanes is not so great as it would be otherwise. Nevertheless, the danger is very real.

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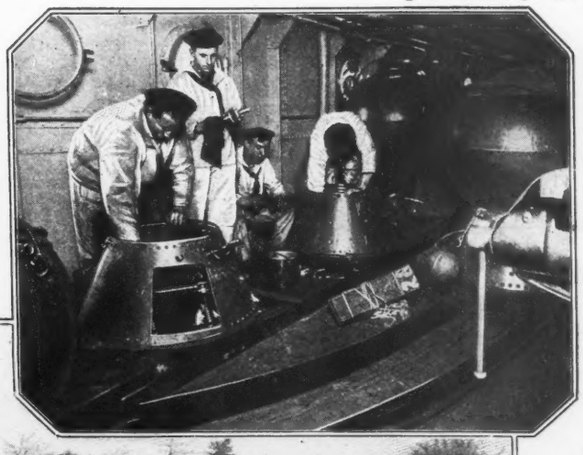


Overhead trolleys and deck tracks make it possible to handle the mines without jarring—and who wants to be rough with 200 pounds of T.N.T.?

© Keystone View Co.

Here are some hundred thousand or more of our own mines, gathered in after doing duty off the coasts of the United States

How They Are Raised

The photographs show two phases of the work—raising the mines and stowing them. Having grappled a mine, the sweeper's crew hoists it on board through the huge open port in the stern. Then, along overhead trolley tracks and flanged deck tracks, the mines are moved to their appointed places, with never a jar.

The interior view shows the sailors at work on mine anchors which contain the automatically operated cable windlasses that hold the mines at just the right distance beneath the surface to be most deadly. The mines themselves can be seen hanging from the overhead trolley.

Roosts for City Airplanes

Solving the difficult problem of landing on a roof

By Carl Dienstbach

The idle machine stands on the circular elevator platform, which fits into the track. Thus the aviators elevate and lower their machines from and to the garage below

LIKE any soaring bird of prey, an airplane must be in motion before it can fly. It must run along the ground before it can vault into the sky. But that is not all: it must make its running start in the face of the wind. This explains why it is possible to confine a condor or a vulture in a narrow cage open at the top.

Street No Place for an Airplane

You can see from this that the problem of flying to and from your office in New York or Chicago reduces itself to the providing of suitable platforms on which you can alight (also in the teeth of the wind) and from which you can start. Clearly, city streets, flanked by high cliffs of architecture, lend themselves about as well for airplane landing and starting as they do for ice-boating. Flying must adapt itself to the wind as much as ice-boating.

Even if a flying-machine could vault into the air from one of the canyons in the Wall street district of lower New York, it would be dashed to pieces against the tall buildings on either side. In order to avoid a catastrophe in starting from a street, the wind must blow exactly in the right direction not only during the preliminary run but also for another minute or so. Within a city, airplanes must land and start above the roofs. Skyscrapers must be avoided as if they were mountains.

There is clearly nothing for it but to use the roofs—a suggestion that has been made time and time again. But this means either a building with a very large roof or a number of buildings of uniform height connected by a common roof. Suppose a number of buildings could be so connected by a roof. Obviously, the common connecting roof must not cut off light and air from the streets below. Some form of iron grating, light and strong, suggests itself.

It is rarely that a group of buildings of uniform height is found, particularly in the skyscraper districts of large cities. To be sure, a solution may be found in the invention of an airplane that can rise almost vertically from the ground. But the present article is concerned with the roofs and the machines of today.

Mr. H. T. Hanson, art director of the POPULAR SCIENCE MONTHLY, proposes what seems to me a method of solving the problem which is worth serious consideration. He would build the platform in the form of a circular, high-banked track —a track that would be constructed of light but strong iron gratings, so that sun and air would still find their way to the streets below.

Landing Against the Wind

Imagine yourself winging your way in an airplane from your country home eighty miles to your city office. An hour after you have started from your own grounds, the lower part of Manhattan looms in sight. There are the three great suspension bridges that span the East River.

Somewhat to the east of the financial district downtown you see the banked track on top of the building on which you are to alight. You head for it. Spiraling down, you touch the bottom dead against the wind—a feat always possible with the circular track, no matter from which quarter the wind may blow. You run on the landing wheels around and around until at last you come to a very easy stop. By manipulating your elevator you prevent yourself from soaring off again.

In the picture that appears on the cover of the POPULAR SCIENCE MONTHLY part of the roof on which the track is built becomes a lift. It is the circular part that fits into the bottom of the track. Thus you run directly from the track upon the lift or *vice versa*. The picture on page 73 shows still another method of combining a lift with the track.

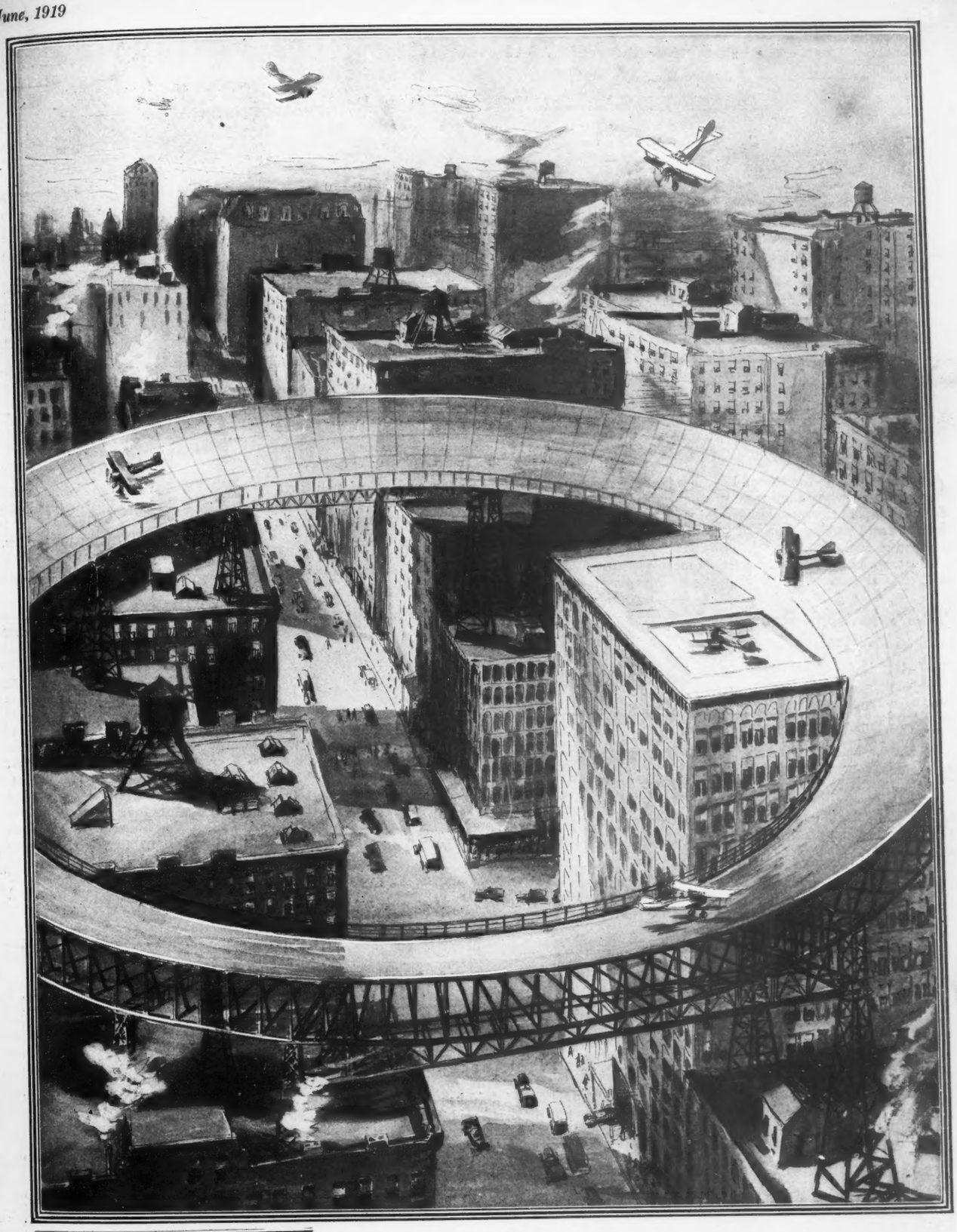
As Easy to Start as to Land

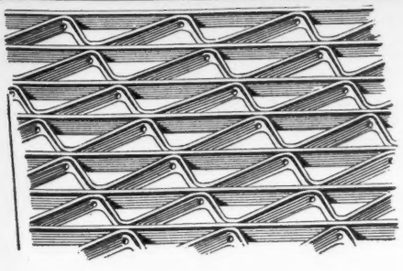
It is just as easy to start from such a circular track as it is to alight upon it. You have but to tilt the elevator in the rear at the precise moment that the wind is dead ahead and to fly off at a tangent.

To carry out this maneuver successfully, a signal is required which automatically shifts on the track to mark very distinctly that portion which happens to be parallel to the wind, but only on that side where the wind is opposite to that of the circling plane.

This, in turn, means that the planes must always circulate clockwise.

The circular landing track could be carried on stilts above several buildings, without cutting off light or air





Would This Circular Track Solve the Landing Problem?

The problem of providing a suitable landing platform for flying-machines in our large cities has always puzzled engineers. This is Mr. H. T. Hanson's interesting solution. A banked track of open iron gratings (its construction is shown by the detail drawing at the left, is carried on latticed towers over a group of buildings. On such a track the pilot can start and alight dead against the wind, as he always must. At one point of the track he runs off upon an elevator platform flush with the roof of a convenient building. By means of the elevator he descends to the garage below

If Coal Is Scarce Use Peat and Coke

COAL men who have been overcharging for their precious commodity—when they were not hoarding it—are about to pay for their sins. For people have learned that they can cook and keep warm by using peat and coke in their stoves and furnaces instead of coal.

Peat, which is decayed vegetable matter—mostly reeds, rushes, sedges, and mosses—is found in bogs. As this matter decays on the surface of ponds, it sinks to the bottom slowly in layers. After several layers are formed, the lowermost ones are gradually compressed and carbonized.

Peat-diggers bring up these layers and cut them in squares, which they pile up to dry. The man in the picture above is stacking up peat that he found in the boggy yard of his home in England.

This Tree Took Root in Itself

MANY linden trees that look healthy are rotten at the core. In time, they develop large cavities.

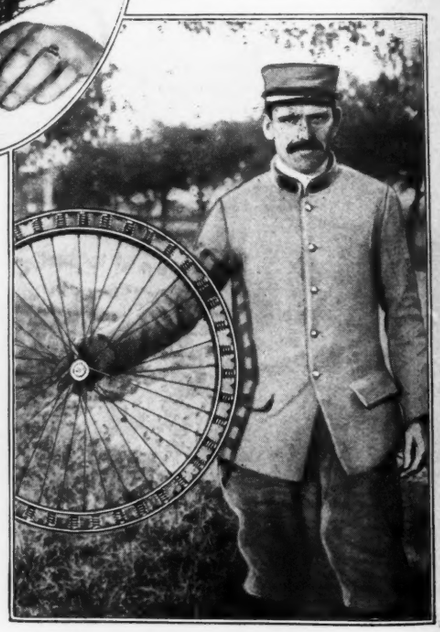
The upper part of the tree shown below was cut off from its source of supply. So it sprouted roots, which reached down until they struck the rotten mold below and there took hold, getting a fresh start.

In most cases like this the tree dies a lingering death.

Springs to Do the Work of Rubber

WHEN Germany had no more rubber, German bicycles seemed doomed until someone thought of motor springs. If motors use springs, why not bicycles?

From that time on German bicycle wheels had rims of springs instead of pure rubber. One of them is shown herewith. The construction shown is about the crudest of thousands of spring inventions patented in the last twenty years.



The Plant that Never Dies

THE florist told her that if she put the dried-up ball of brown leaves into a dish of water it would blossom out into a fresh green plant in a day. Skeptically she did it and when the twenty-four hours were up, lo, the plant had bloomed, giving out a sweet, heavy Oriental odor.

It brought this odor with it from the far-off Holy Land, where it grew. It is another miracle of that miracle land, for it never dies. When it is out of water it rolls up into the dried-up ball, and will keep that way for years until it is put in water again. It is called the resurrection plant.

A Submarine's First Bath

IF the war hadn't ended this submarine would now be "over there" and in the thick of the fight; but of course we couldn't keep the war going just to give this submarine her chance.

She is the S-34, built and launched in San Francisco, and is one of the most deadly of undersea boats. She belongs to the 800-ton class and is 170 feet long.

By now Germany knows full well her mistake in laughing at England's "contemptible little army" and in prophesying that "America won't fight."

© International Film Service

Your Health in a Glassful of Dog

THIS pup isn't a "long drink of water" even if he does fill a glass. He's just about the smallest dog that ever was or will be—one of those pups that women tuck into their muffs or up their sleeves. You'd never know they were there if it were not for the sparkle of their beadlike eyes.

He is a toy dog of Yorkshire breed, and is worth at least a hundred dollars a pound, for the less there is to a toy dog the more expensive he is.

From the expression of his eyes, he isn't quite sure that he likes being tucked into a glass. For he has found that, when he tries to move, only his head and one paw will work.

Just the Same, We Hold It's a Bear

"IT'S a bear!" said W. C. Strickler, when he happened on this at Lake Cayuga, N. Y. "A petrified bear."

But when members of the Academy of Natural Sciences at Philadelphia looked at it, they were not the least impressed by the two very real eyes in the places where eyes should be, and they called it plain stone—or, to be exact, two stones of widely separated periods that had got mixed up.

The eyes are part of the under stone which has cropped to the surface, and it bears the awe-inspiring name "corniferous rock of the Devonian Age."

Ironing-Day Is Pounding-Day in Korea

KOREAN clothes are washed, hung up, dried, and dampened just as ours are; but when it comes to smoothing out the wrinkles our ways part. We iron—they pound.

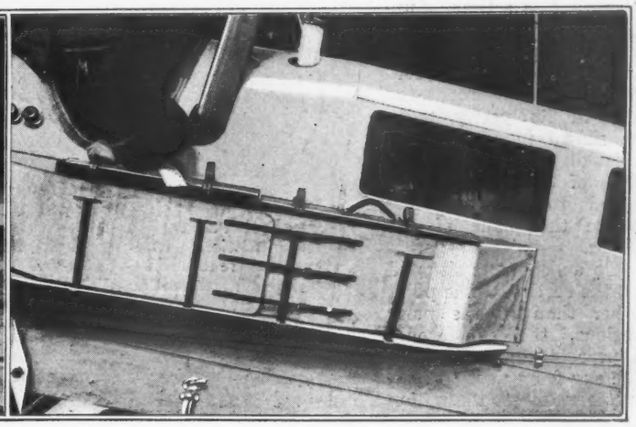
Mother and daughter spread a grass mat on the ground, place a stone in the middle, and on the stone the wash. Armed with Indian clubs, they squat on either side of the stone and pound until they have driven out all the little molecules of water and, incidentally, the wrinkles. It takes half a day of steady pounding to smooth out one coat.

This Airplane Even Has a Suitcase-Rack

JUST as French railway trains conveniently accommodate either horses or men, so this airplane will accommodate either bombs or men. It is large enough to carry sixteen passengers and their suitcases.

The passengers travel in the cabin behind the pilot, and the suitcases travel in a rack outside.

The base of the rack is a thin metal strip fastened to the side of the airplane. The suitcases are placed on this rack, and two canvas strips are strapped around them to hold them securely in place.



Finding Your Way Among the June Stars

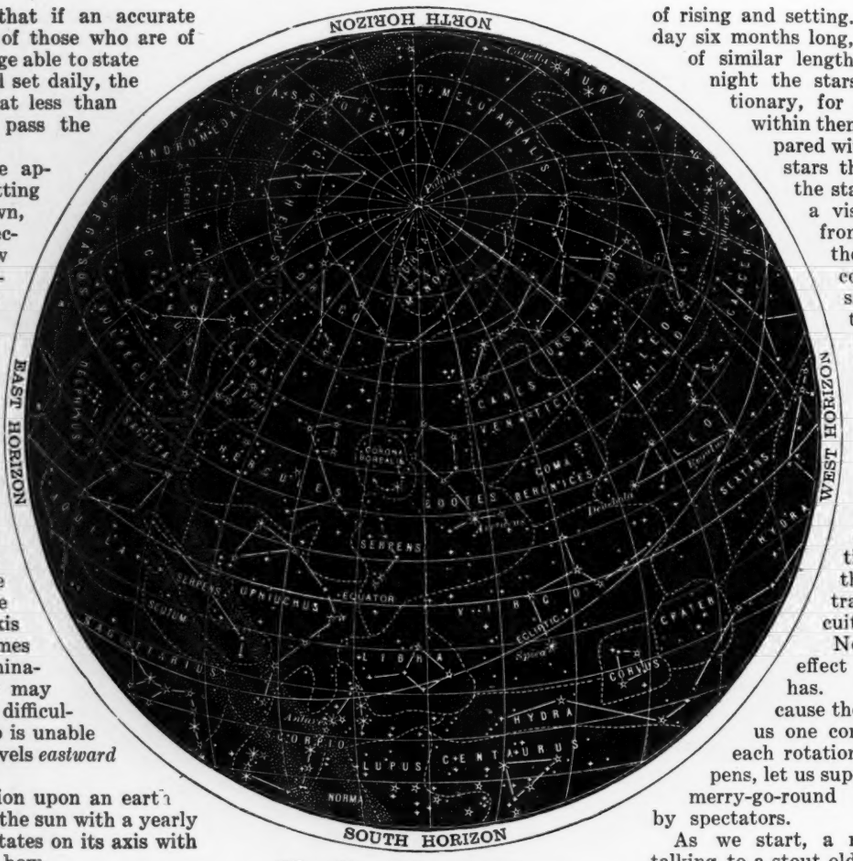
The stars "rise" and "set" for the same reason that the sun does

By **Ernest A. Hodgson,** *of the Dominion Astronomical Observatory*

IT has been said that if an accurate count were made of those who are of their own knowledge able to state that the stars rise and set daily, the result would show that less than fifty per cent could pass the test.

The reason for the apparent rising and setting of the sun is well known, and a moment's reflection suffices to show that for the same reason the stars must rise and set also. It will be of interest to examine this daily motion a little more closely. If the question were asked, "How often then does the earth rotate on its axis in a year?" the answer would in most cases be, "365 approximately." That would be wrong, however, as the earth rotates on its axis approximately 366 times in a year. An examination into this matter may help to clear up the difficulties of the reader who is unable to see that the sun travels *eastward* among the stars.

We occupy a position upon an earth which revolves about the sun with a yearly motion, and which rotates on its axis with a daily one. To us, however, our location appears fixed, and these motions appear to be possessed by the stars and other celestial bodies.



The Star Map for June

The map represents the appearance of the sky at the times listed below. It is specifically arranged for the latitude of New York, 40°N., but is practicable for ten degrees on either side of this latitude.

May 8, Midnight.
May 15, 11:30 P. M.
May 23, 11:00 P. M.
May 31, 10:30 P. M.
June 7, 10:00 P. M.
June 15, 9:30 P. M.
June 22, 9:00 P. M.
June 30, 8:30 P. M.
July 8, 8:00 P. M.
July 15, 7:30 P. M.
July 23, 7:00 P. M.
July 30, 6:30 P. M.
Aug. 8, 6:00 P. M.

The magnitudes are indicated on the map by stars of various kinds as follows: 0, open center; 1 eight points; 2, six points; 3 five points; 4, four points; 5 is indicated by a single point. All time in Eastern Standard (not summer).

If the Earth Ceased Its Daily Rotation

To grasp the idea of the effect of these movements upon the appearance of the sky, let us consider them one at a time. Suppose, first, that the earth has ceased to rotate upon its axis, but that it continues to move about the sun in its yearly path, as shown in Fig. 1. In this diagram the North Pole of the earth is supposed to be projecting above the plane of the paper.

To an observer situated on the earth at some point other than at the polar regions, the sun would appear to move across the sky from west to east, just opposite to its motion

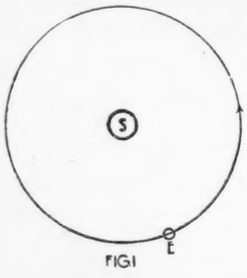


FIG. 1

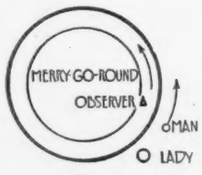


FIG. 2

The effect of the earth's double motion — rotation and revolution — on the apparent motion of the sun is illustrated by a man on a moving merry-go-round counting his revolutions from a man who is walking in the same direction

of rising and setting. We should have a day six months long, followed by a night of similar length. During the long night the stars would appear stationary, for the earth's orbit is within them, and is so small compared with the distance to the stars that the directions to the stars would not exhibit a visible change as seen from opposite sides of the orbit. If the stars could be seen at the same time as the sun, the latter would be found to be moving eastward among them in such a way that it would complete a circuit of the sky in a year.

We may suppose, therefore, that the earth has only one motion—that of rotation on its axis—and that the sun really travels eastward a circuit a year.

Now let us see what effect the daily rotation has. This will evidently cause the stars to move about us one complete revolution for each rotation. To see what happens, let us suppose ourselves upon a merry-go-round that is surrounded by spectators.

As we start, a man, who has been talking to a stout old lady, begins to walk around the inclosure in the same direction as the machine is going, but only one tenth as fast. You decide mentally to count the turns made by reference to the old lady. Your friend decides to count them by reference to the man. When you count one your friend has not yet reached his reference mark. When you count two he is still farther from his second count. When you count ten turns by reference to the old lady, your friend simultaneously counts nine turns by reference to the man, who has now reached the lady's side again.

Counting the "Turns" by the Sun and the Stars

The same phenomenon holds good in the appearance of the sky. We count a "turn" by reference to the sun—the moving man—which passes slowly eastward among the stars, due to the earth's yearly motion.

These "turns" we call the 365 solar days. They are not actual turns, however. These can be counted by reference to the stars. Choosing some particular star—the stout old lady of the illustration—we count 366 turns per year. These, however, must be referred to as "sidereal" days.

How to Find the June Planets

THE positions of the planets for the current month are shown, in the usual way, on the planet map. It will be noted that they are, with the exception of Uranus, near to the sun.

Mercury at the first of the month is west of the sun and rises as a morning star. It moves rapidly eastward among the stars, coming into superior conjunction on June 11. It then passes to the east of the sun, and sets after it as an evening star.

Venus continues to set as an evening star. It is of interest to determine how long Venus continues above the horizon after the sun has set. This may be done by means of the disk cut out and pinned over the map. For example, on June 16 it sets about three hours after the sun.

Mars is west of the sun, and rises as a morning star shortly before daybreak.

Jupiter and Saturn set as evening stars, the former setting before and the latter after Venus. The three planets are close together in the evening sky.

Conjunctions with the Moon

There is a conjunction of Venus and the moon on June 1, and of Saturn and the moon on June 3. On June 26 Mercury and Jupiter are in conjunction. They set about an hour after the sun. Jupiter can probably be seen, but Mercury will be difficult to detect. It will lie about a degree and a half to the north of Jupiter. There will be a conjunction of Jupiter and the moon on June 28.

The positions of Uranus and Neptune are indicated on the planet map. They are invisible without optical aid.

The times of the phases of the moon may be determined from the planet map. New moon occurs when the moon is in conjunction with the sun. Full moon is when the moon and the "earth's shadow" are in conjunction. First quarter may be found by determining when the moon is approximately six hours to the east of the sun. Last quarter is when it is the same distance to the west.

The following simple rule will enable one to determine the age of the moon at any given date in any year.

To Discover the Age of the Moon

There are three numbers to be added—the year number, the month number, and the day number. The year number is the number obtained by subtracting 1911 from the year and multiplying the result by 11. (The recurrence of 11 is an aid to memory.) The month numbers may be remembered by grouping the months two and two with the following numbers:

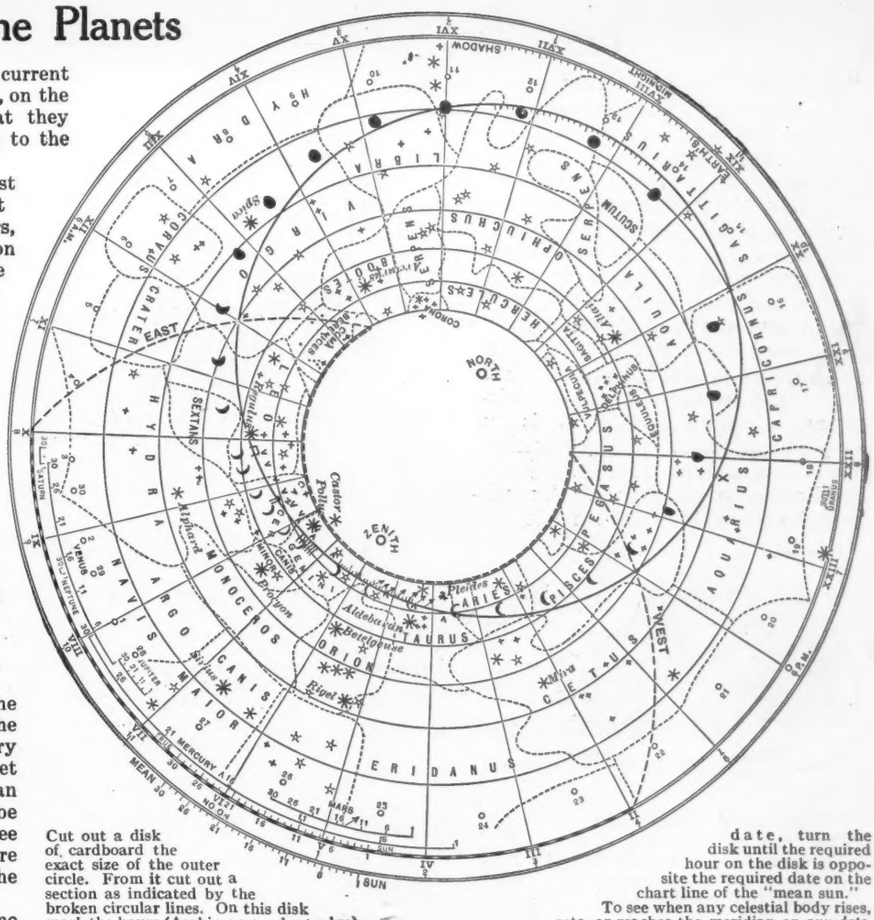
J-F	M-A	M-J	J-A	S-O	N-D
0-2	0-2	2-4	4-6	7-8	9-10

The day number is simply the day of the month. These numbers are to be added. Since the moon cannot be more than thirty days old, thirty is to be taken from the sum as often as possible, and the remainder is the age of the moon. 0 days indicates new moon; 7 days indicates first quarter; 15 days indicates full moon; 22 days indicates last quarter.

An example showing the application of this rule may be taken for the current month—say June 13, 1919:

The year number is 11 times (1919-1911) or 88. The month number is (see above) 4. The day number is 13. The sum is 105, and subtracting 30 from this three times we have left 15.

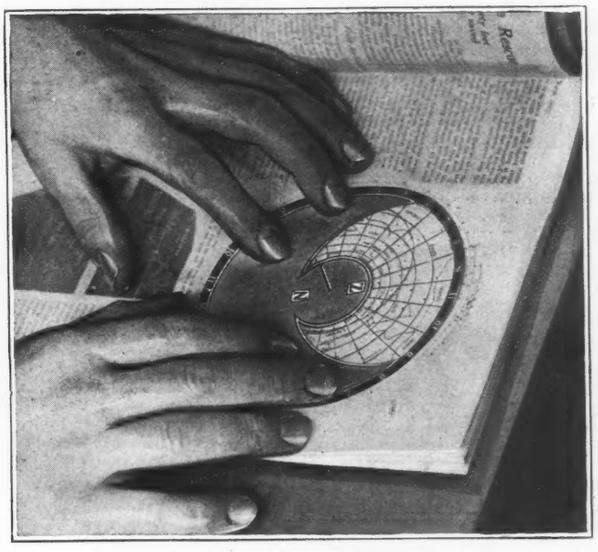
Therefore the moon is 15 days old—that is to say, full moon—on June 13, 1919.



Cut out a disk of cardboard the exact size of the outer circle. From it cut out a section as indicated by the broken circular lines. On this disk mark the hours (Arabic numerals at edge), A. M., P. M., North, East, West, and Zenith. Run a glass-headed push-pin through the center of the disk, pinning it to the center of the map.

To see the section of sky visible at any time on any date, turn the disk until the required hour on the disk is opposite the required date on the chart line of the "mean sun."

To see when any celestial body rises, sets, or reaches the meridian *on any date*, turn the disk so that the position of the body *for that date* is in the required position with respect to the horizons. Read off the hour opposite the position of the mean Sun *for that date*. The disk in use is shown below



Illustrating how to use the planet map according to the directions printed above

Signs of the Planets

MERCURY	☿
VENUS	♀
MARS	♂
JUPITER	♃
SATURN	♄
URANUS	♅
NEPTUNE	♆
SUN ☉ AND MOON	☾

The POPULAR SCIENCE MONTHLY *is publishing every month an article like this by Mr. Hodgson. If you feel that these articles can be made more helpful, or if there are any questions that you would like to ask, write to the editor.*

Speech Is Difficult in an Airplane

"LET go that joy-stick!" says the instructor in the observer's seat to the student pilot in front. The student promptly lets go, thereby saving himself, the instructor, and the airplane from a crashing fall. Had the instructor shouted through the air his student would not have heard him, even though they were only a few feet apart. The roar of the engine, the rush of the wind, both would have drowned his shouts.

He used some sort of telephone, you say. No, a telephone wouldn't do. What he did use was an airphone, so called because it is an air-phonetic device—not an electrical one. It was invented by Benjamin F. Miessner, of New York. A speaking-tube is used instead of a telephone wire, and this eliminates the electrical transmission of external noises from the mouthpiece to the ears of the listener. This tube was invented by Mr. Miessner after he had made a careful study of airplane noise conditions — wave lengths, resonance, vibrations, and such things.

In spite of ear-splitting airplane noises, the pilot hears plainly what the observer says through this speaking-tube

The listening airman wears a cap that boasts of pneumatic ear cushions, these being connected with the speaking-tube

For instance, the motor exhaust sounds that occur with fairly uniform frequency are the noisiest ones of the airplane. Mr. Miessner figured out their wave lengths, and varied the length of the tube accordingly, so that there would be no amplification of sound in the tube because of resonance. The material for the tube was picked for its lightness, durability, flexibility, and its ability for preventing the escape of voice sounds and the entrance of airplane sounds. Its dimensions allow for maximum clearness.

The speaker talks into a simple mouthpiece which is not hampered by diaphragms and forced vibrations, as is the telephone transmitter. The sound travels smoothly along to the ear-pieces of the listener. These ear-pieces are really pneumatic cushions in the aviator's cap which surround the ear openings and are in air-tight contact with the head. This bars outside noises.

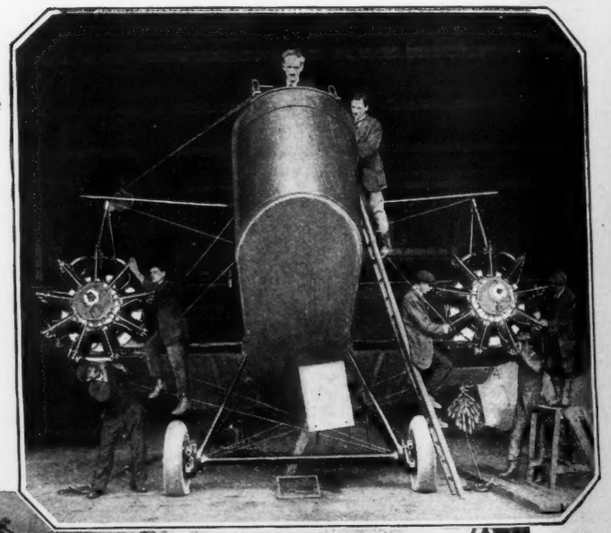
Of course absolute silence does not reign in the tube when the speaker isn't speaking, but at least the airplane noises are shut out sufficiently to make the voice perfectly clear.

Real Ships of the Air

THE first airplanes were "all wings." Pilot, passengers, engines, tanks, radiators, and what-not were simply dumped over the lower plane. The writer recalls vividly a conversation among the members of the Aerial Experiment Association at Hammondsport in August, 1908, about the designs for the *Silver Dart*, the forerunner of the first practical Curtiss machine. A body to house the engine, etc., was suggested, but dismissed as useless and weight-wasting.

Today the body—the fuselage—is the most essential part of the whole design, since the genius of Nieuport has shown that the time-honored belief that an airplane's wing surface increases only as the square and its weight as the cube of the linear dimensions holds true only for the antiquated "all-wing" type. Since the fuselage came into its own, it has become recognized that the fuselage obtains the same advantages from an increase in size as does the hull of a ship. The larger it is, the more space relatively for housing all sorts of things, and at the same time the less the head resistance.

Now we know, at last, that the lift of a fast airplane depends far less on the relative size and weight of the wing surface than on the total head resistance, and that its head resistance, just as in a ship, becomes relatively smaller as the craft grows larger.



Designed to carry bombs to drop on Berlin, this airplane is easily transformed into a commercial airplane. The multiple motors of giant airplanes (*above*) are placed in little bodies of their own

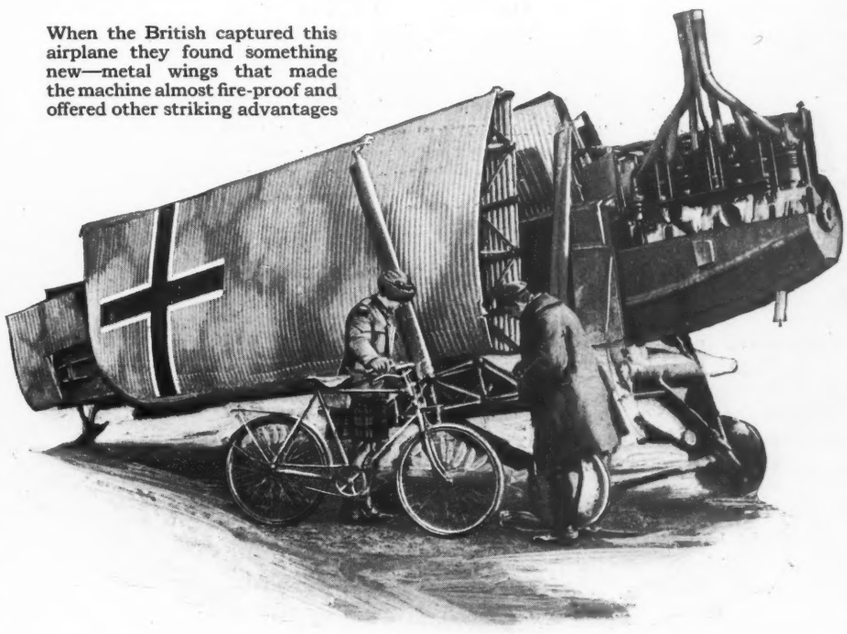
An Airplane with Metal Wings

This captured German machine took a lesson from the Zeppelin

BUILT to attack infantry at close range, this German armored airplane captured by the English is interesting to peace-time students because of the apparent effort that has been made to render the machine non-combustible. If provision has also been made to scuttle the gasoline-tank at need, even a burning tank would not be a serious menace to such a machine.

In attacking trenches the airmen learned early that their machines were likely to "collect" veritable swarms of machine-gun bullets. The bullets would rattle off harmlessly from the armor, and the tiny holes made in the wings could be disregarded; but the matter became serious with the invention of the flaming phosphorus bullet.

Presumably the experience in building Zeppelins taught the Germans how to meet this peril. The Zeppelin cars were covered with corrugated aluminum, and it was only a step to cover airplane wings in the same fashion.



When the British captured this airplane they found something new—metal wings that made the machine almost fire-proof and offered other striking advantages

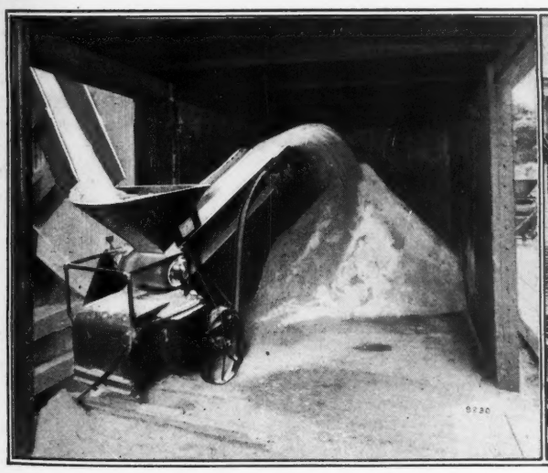
But this plan developed great changes. The stiffness even of corrugated thin sheeting seems negligible in itself, but it becomes a very important factor if it is braced up by a suitable framework. Since the framing is made of aluminum, exactly as in a Zeppelin, and the wings can be made so thick that they become entirely self-supporting without undue increase of weight, the wasteful nuisance of wires and struts has finally been dispensed with.

They Are Getting a Load On in a Hurry

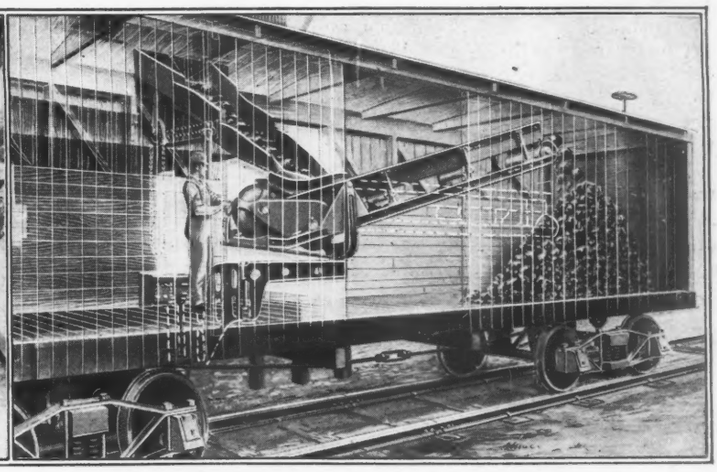
TWO men and the machine shown here handling coal will load a box-car in thirty-five minutes. It takes three men two and a half hours to do the same work. Therefore this machine does the work of five men.

The loader is placed just within the door of the car. The load comes down a chute, lands in a metal hopper on the loader, passes through, and hits a swiftly moving motor-driven belt which carries it into the ends of the car. A man regulates the angle at which the belt is to work and also its speed.

The other, smaller machine shown here works faster and throws its load by its very speed into the far corners of the car. Therefore only unbreakables are thrown from it. The most frequent riders are glass sand, blast sand, fertilizer, ground limestone, rock salt, and nitrate. The machine will throw out a ton of sand a minute. It is mounted on wheels and can be moved around so that it will shoot its stream in a different direction.



When the sand hits the belt it is thrown in every direction by the speed of the belt



The coal "shoots the chutes" and lands on a moving belt, which carries it to the four corners of the car

Compressed Air Faces Its Greatest Battle

Building a two-story tunnel of concrete under the Hudson river

By Robert G. Skerrett

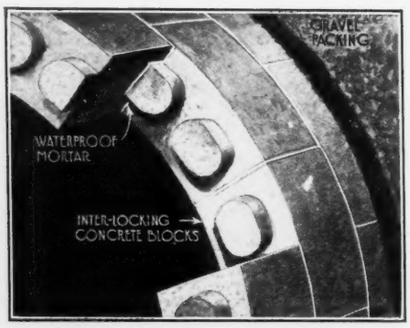
THE mason's master task awaits him half a hundred feet below the tide of the Hudson river. General George W. Goethals is ready to stake his reputation in building a great vehicular tunnel, fashioned of concrete blocks, to span the water gap between New York city and New Jersey. The choice of this material is in itself an amazing novelty for such an undertaking, and the project otherwise has warrant enough for wonderment. A comparison will help to a fuller realization of the unusualness of the scheme sponsored by the General.

London's Vehicular Tunnel

The Rotherhithe single-level vehicular tunnel under the Thames at London has a maximum external diameter of 30 feet, runs under the water for 467 yards, and from portal to portal measures 4,863 feet. In driving the way for that structure, built up of cast-steel segments, the excavating "shield" cut its path through a firm bottom composed of clay intermixed with loam, pebbles, and shells. This earth formed a "blanket" which greatly helped to hold in place the needful air at the face of the shield, so that the workers could stand out under the sheltering apron and do their digging. So firm was the substance of the river's bed that an advance of twelve feet was considered a good day's work.

Even with the advantage of a compact bottom through which to burrow, the shield called for an hourly supply of 1,000,000 cubic feet of compressed air to hold the mud and water at bay. Now see what the double-level Hudson tunnel will involve in its building. The outside diameter will be 42 feet, the shield having a frontal area nearly twice that of a 30-foot apparatus, and its lower edge will lie not less than 92 feet below mean low tide. More than 2,000,000 feet of compressed air per hour will be needed in this undertaking.

For every foot of submergence the water-pressure increases at the rate of .43 of a pound; and between the top and bottom of the Hudson tunnel shield there will be a difference of 18 pounds pressure. This will invite grave risk if the bottom is not stable. The mud in the Hudson is known to be soft, and may therefore be easily displaced by the pent-up air seeking to escape upward from the front of the shield. A "blow-out" of this sort might mean certain death to the men laboring under the apron and possible harm to those within the shield. To juggle with the contending forces of air and water, it may be found necessary to lay a blanket of sail-cloth surmounted by clay and sand over the river-bed above the line of the tunnel.



General Goethals' plan is to build the Hudson vehicular tunnel of interlocking blocks of concrete three feet thick

Interlocking Blocks of Concrete

As the shield moves forward, the masons will build the tunnel at the same pace, using for their structural units interlocking segmental blocks of concrete three feet thick. As rapidly as these are set in place the joints will be made tight from the outside by means of a special waterproof mixture. The inner face of each seam will be caulked, and the whole interior of the joint, between the blocks and their interlocking recesses, will be filled with mortar forced in under pressure. Finally, the inner face of the tunnel will be coated with white cement of a hydrolithic type.

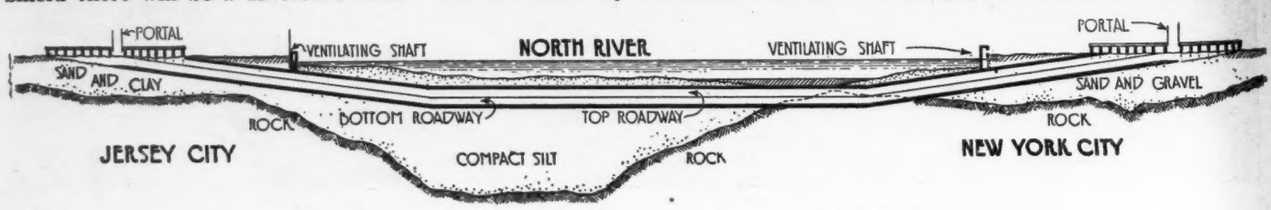
Completely to fill the space between the cut made by the shield and the exterior of the great cement sheath, gravel will be passed through the tail of the shield and driven into place around the outside of the tunnel structure, thus binding the tube to the river-bed and unifying the compressive force from without in a manner tending to make the circular sections stronger and more firmly set. The partitions, roadways, walks, ducts, etc., will be fashioned of steel, reinforced concrete, etc. Certain parts of these features will be fastened to the main body by means of sturdy anchor-bolts.

The internal clearance of the tunnel will have a diameter of 36 feet. It will be divided horizontally into an upper and lower level, each having a driveway 22 feet 6 inches from curb to curb. It will carry six lines of traffic, three moving eastward and three westward.

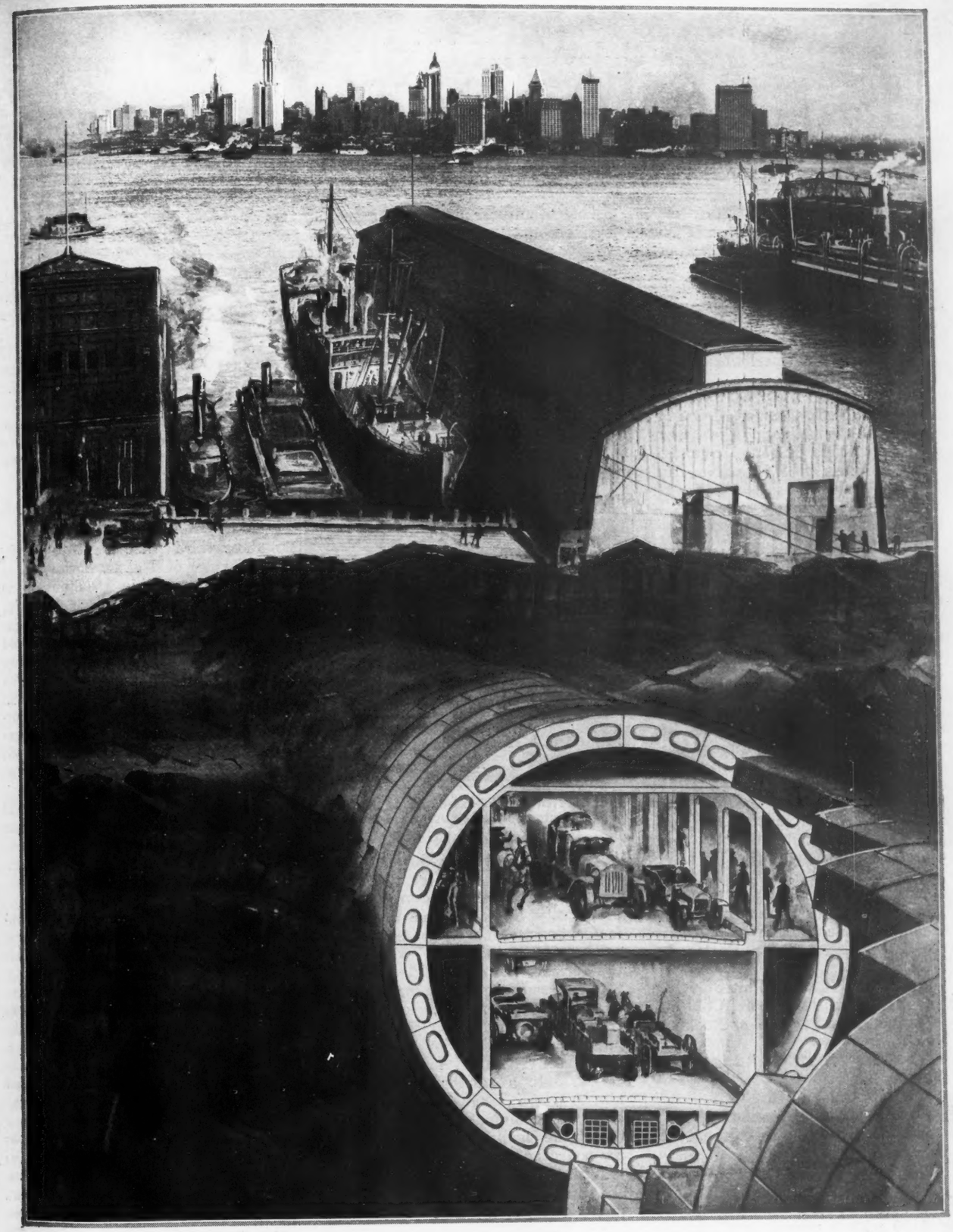
Ventilating the Passageways

By means of electrically driven blowers the two levels will be thoroughly ventilated, so that the carbon monoxide exhausted by motor vehicles can be drawn off promptly, and other blowers will force in a steady stream of fresh air. The under-water section of the project will have a reach from shore to shore of 5,300 feet, and from portal to portal the total span will be 8,050 feet, which is 3,187 feet onger than the Rotherhithe structure. It is estimated that the entire project can be finished well inside of four years, at a total outlay of $12,600,000. The approaches will have a 3½ per cent gradient, and from end to end the vehicular tube will be lighted by electricity. On the upper level there will be walks for pedestrians.

The tunnel will easily accommodate a daily movement of 100,000 vehicles and exceed a 24-hour carrying capacity of 75 big ferry-boats running continuously. Where fog and ice would interfere with the water traffic, the subaqueous highway will be available without interruption. There are the best of reasons for believing that this tunnel, charging less than the ferries, would pay for itself in twenty years.



Showing the character of the material through which the tunnel will be built. One of the dangers to be overcome is the soft mud of the river-bottom, which invites "blow-outs"



New York Digs a New Way Out

With a large portion of the food supply of 7,000,000 people having to be carried across the Hudson, the necessity of adding to the means of getting over the river has long been evident. The new vehicular tunnel will be a two-story one, allowing the streams of traffic to flow in both directions uninterrupted. There will be special passageways for foot passengers. The tunnel will be 8,050 feet long, with an under-water section of 5,300 feet, being longer by 3,187 feet than the Rotherhithe single-level vehicular tunnel under the Thames at London. It is estimated that 2,000,000 feet of compressed air per hour will be needed to provide safety for the builders. More than 100,000 vehicles can pass through it in a day. The cost is estimated at $12,600,000

Uses to Which an Old Car May Be Put-

C. A. BUTTERWORTH, of 15 Chase street, Newton Center, Mass., has won the first prize of $150 in the POPULAR SCIENCE MONTHLY $300 Contest for the best idea for utilizing an old passenger-car that has outworn its usefulness as a mode of transportation on account of its old style or mechanical deficiencies.

The second prize of $100 has been awarded to E. L. Candler, of Grand Canyon, Arizona, and the third prize of $50 to R. H. McQuade, whose address is R.F.D. No. 10, Box 386, Dallas, Texas.

The great number of excellent ideas submitted from all parts of the United States, and the great variety of the methods proposed by the contestants as to how cast-off passenger automobiles might be put to good use, made the task of the judges in picking the three prize-winners a most difficult one. In fact, so many excellent ideas were submitted that the judges felt it only fitting and proper that a list of "honorable mentions" be included. While, of course, no more than the three prizes originally announced with the conditions of the contest in the February and March issues of the POPULAR SCIENCE MONTHLY can be awarded, all of the ideas submitted by the contestants in the following list will be published, together with illustrations, in subsequent issues of this magazine. Those entitled to a place on the list of honorable mention are as follows:

J. K. DELANO, North Dartmouth, Mass.

JOHN A. PRIOR, United States Naval Hospital, Fort Lyon, Col.

GEORGE AURINGER, New Rockford, No. Da.

R. BATES WOOTERS, Adrian, West Va.

D. P. PATTERSON, Rio, N. Y.

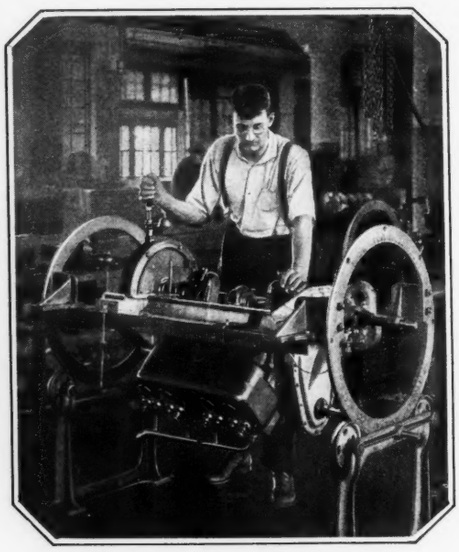
BOYD STICKLEY, Strassburg, Va.

JOHN D. LOWRY, Wilmington, N. C.

The Best Idea

Mr. Butterworth won the first prize of $150 with a unique and practical method of converting the old automobile into a farm tractor. The farm tractor is today in about the same relative stage of development as was the automobile fifteen years ago and the motor-truck five years ago.

Of course, the service imposed upon a farm tractor is as strenuous as that of the average automobile, if not more so, on account of the continuous running that the tractor must do to cover a field in any farming operation. On this account, any old passenger-car, to give satisfactory service after being transformed into a farm tractor, must be in nearly first-class condition so far as its operating and power-transmission mechanism is concerned. It would not be wise to try to convert



Shorten your labor by turning your old automobile into a useful machine

a car with a broken-down engine, slipping clutch, worn gear-set, and rear axle into a farm tractor; for in all probability it would give less satisfactory service than as a passenger-car.

The idea is especially valuable for the farmer with a small acreage on which he is not sure that a new tractor, costing somewhere between one and two thousand dollars, would be a paying investment. For such a farmer the conversion of his old passenger-car into a tractor would enable him to pass through his initial stages of power farming at a small cost, even though he should have to discard the converted vehicle after a year's use.

With the tractor operation and its advantages once fixed in the farmer's mind, he might be able to procure a larger acreage to work, and embark on it with a new and specially designed tractor which he would be in a much better position to operate and take care of as a result of his experience with his first makeshift unit.

Winner of the Second Prize

E. L. Candler, the winner of the second prize, submitted a most elaborate plan for the use of the old passenger-car's engine as a form of farm power. In his plan, the engine's power is used to operate a vacuum cleaner for the farm-house, thus lightening the house-cleaning duties of his wife and daughters; a drinking-water pump; a corn-sheller; a corn-grinder; a cream-separator; a dynamo to furnish current for electric lights; a churn; and a saw-table to cut the winter's supply of wood.

The full description and drawings of Mr. Candler's layout will be published in the POPULAR SCIENCE MONTHLY for July.

The Third Prize

The third prize went to R. H. McQuade, of Dallas, Texas, for a combined portable gasoline engine power plant and air-compressor for farm use. The engine of the old car is used and mounted on the old car's front axle, wheels, and tires, so that it may be easily transferred from place to place on his own farm or hauled behind another passenger-car to a neighbor's farm. It is provided with a belt-power take-off, so that it may be used for any or all of the farm chores.

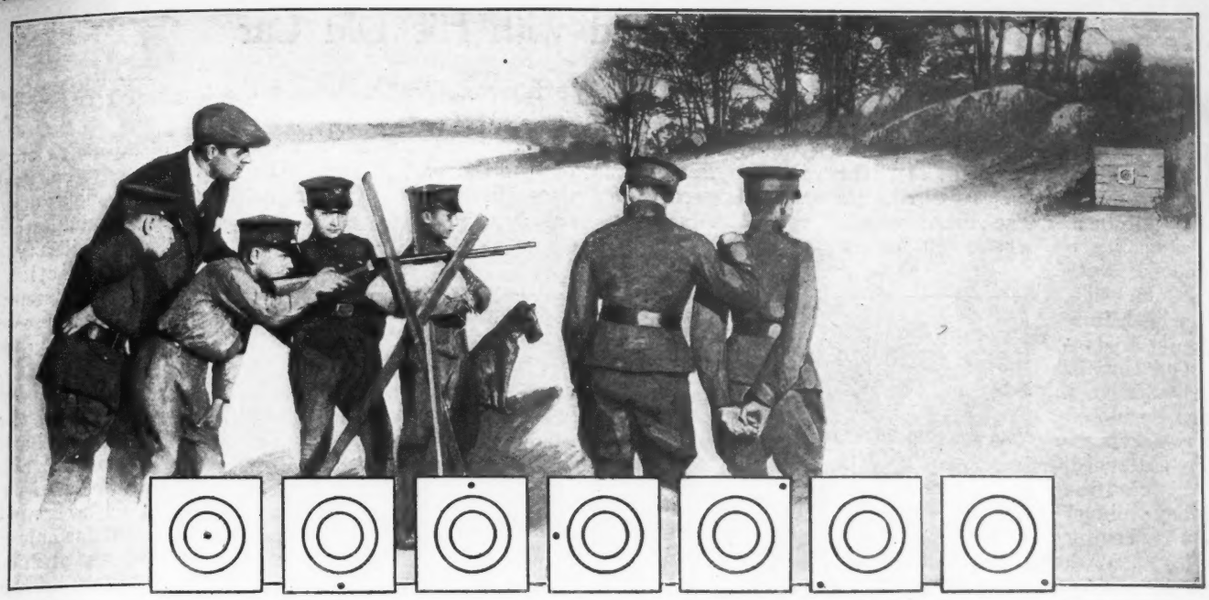
The full details of the plan will be published in the August issue of POPULAR SCIENCE MONTHLY.

Simplicity of First Prize Idea

Mr. Butterworth's method of converting the old automobile into a farm tractor is a simple one. The rear axle is first removed and then bolted up close to the car-frame, after discarding the rear springs. Steel wagon wheels are then mounted in place of the pneumatic-tired wood ones, but on a solid axle and a sprocket fitted on the inside of each steel wheel. A wood frame is then mounted on top of the old car-frame, and utilized to carry a system of gears by which the power from the car engine is transferred to the rear wheels by two side chains. The wood frame extends back of the car-frame for a short distance, and also serves as a support for the draw-bar for the connection of the plows or other implements hauled.

A power take-off with a pulley for belt work may also be fitted at the front end of the car, which is otherwise unchanged. The various details of the converted machine as shown in the accompanying illustrations are fully explained in the author's description on page 84.

THE EDITORS.



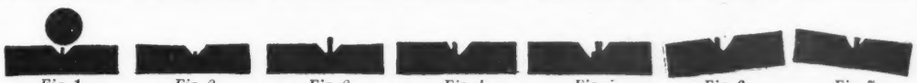


Fig. 1 Full open sight. Correct aim

Fig. 2 Fine Sight. Low shot

Fig. 3 Too full. High shot

Fig. 4 Not centered. Left shot

Fig. 5 Not centered; too full. High right shot

Fig 6 Sight inclined. Low left shot

Fig. 7 Sight inclined. Low right shot

In this simple sighting stand the rifle in pillowed on a bag of loose earth. When the boy thinks he has lined up the sights on the target, the rifle will hold its position while the instructor sights along the barrel to see if the aim is correct.

How to draw a bead on a mark

Sharpshooter Medal

IF you don't know the best way to sight a gun and plug the target square in the bull's eye, it will pay you to study the diagrams on this page. These diagrams are taken from the book of instructions furnished to members of the Winchester Junior Rifle Corps.

Instruction in alignment of sights, the three correct positions for shooting, rules for gun safety are given to every member of the Winchester Junior Rifle Corps. Every fine point that makes for expert shooting is taught in this organization of expert boy Marksmen of America.

Start a W. J. R. C. "Unit" with your friends

Why not get together with half a dozen of your chums, join the Winchester Junior Rifle Corps and organize a regular Unit which will be officially recognized by National Headquarters?

The W. J. R. C. will help you from start to finish in rigging up an indoor or outdoor range. It provides for officers, supervisiors and adult instructors to make your shooting safe. It costs you nothing to join the W. J. R. C. There are no dues and no military obligations. The W. J. R. C. was organized solely to encourage better marksmanship and better sportsmanship among boys and girls of America. Any boy or girl not over 18, who is in good standing in his or her community, is eligible.

Membership in the W. J. R. C. covers the United States. There is hardly a town now that has not at least a small "Unit" of the big national organization where boys are learning to become expert riflemen and are competing among themselves for the famous Winchester Marksman, Sharpshooter and Expert Rifleman Medals.

Get the official plan and handbook

Write today for the Winchester Junior Rifle Corps "Plan for organizing a W. J. R. C. Unit," and for the official hand-book "How to handle a rifle safely." This booklet tells you all about the W. J. R. C. and describes in detail the fine points of shooting.

If you are a boy scout give your name in full, the troop you belong to and the name of the scout master.

If you are not a boy scout, state what boy organization, if any, you belong to, giving the name of the official in charge.

National Headquarters

Winchester Junior Rifle Corps

275 Winchester Ave., New Haven, Conn., U.S.A.

Division 620

Standard types of .22 caliber Winchester Rifles, popular with members of the Winchester Junior Rifle Corps.

WINCHESTER *MODEL .06. Take-down Repeating .22 caliber rifle, 20-inch round barrel. Shoots three sizes of ammunition. The most popular .22 caliber repeater, used extensively by members of the W. J. R. C.*

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Winchester Junior Rifle Corps
National Headquarters, 275 Winchester Ave.
New Haven, Conn., U. S. A. Division 620

Gentlemen:

Please register my name as a member of the Winchester Junior Rifle Corps, and send me a membership button and certificate of membership. Also tell me how to organize a Local Unit of the W. J. R. C.

Very truly yours,

Name _____

Street Address _____

City _____ *State* _____

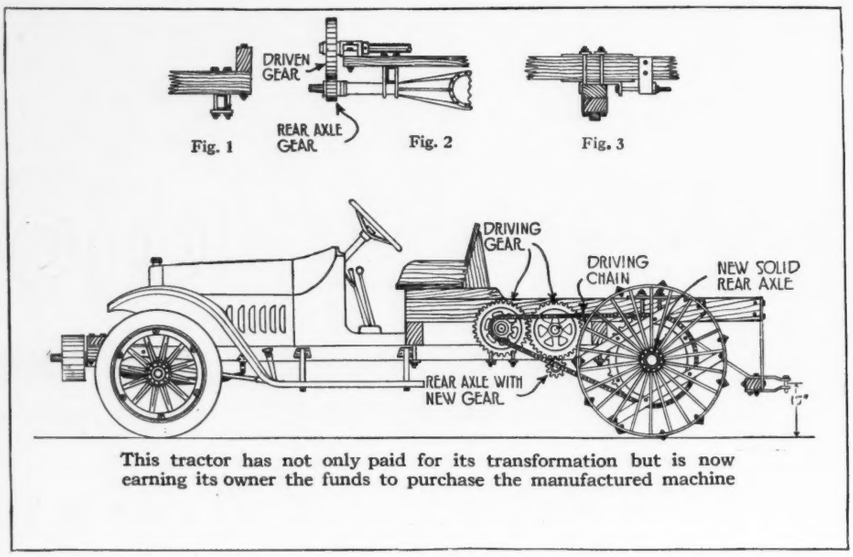
What One Man Did with His Old Car

By the winner of the First Prize, **C. A. Butterworth,** *with his own drawings*

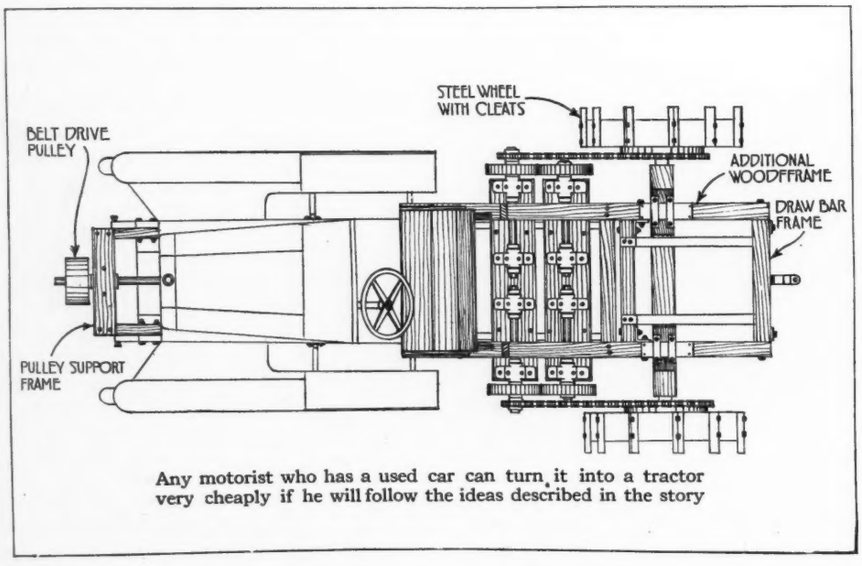
THE construction of this tractor is mainly of wood, and the other materials required are easily obtained. The drive wheels are steel wagon wheels 40 in. in diameter, with rims 6 in. wide. Bull wheels from a binder are better if obtainable, as they have a wider tread and the sprockets are already attached. In this case the regular binder chain is used for driving. With the wagon wheels old motor-truck sprockets are used, fastened to the wheels with cross-bars of 2½-by-½-in. iron, as shown.

In beginning construction, first strip the rear axle of the automobile of wheels, brakes, and springs. Bolt the axle up against the frame with U-bolts, which pass through a 2-by-10-in. oak plank, as shown in Fig. 2. If the differential housing is so high as to interfere, blocks can be placed between the axle and the frame. Now bolt another plank to the frame just in front of the first one.

Next, cut two cross-pieces from 3-by-6-in. stock, making them one foot longer than the outside width of the frame. Bolt one of these on to the end of the frame, the other about four feet forward. Place ½-in. bolts as shown in Fig. 1. Bolt on the two long frame pieces, which should be made long enough to project 3½ ft. beyond the rear cross-piece. Now put in place the two cross-pieces which fit in between these. Fasten the one at the end with lag-screws, and place the other, to which the draw-bar braces are attached, 3 ft. forward and bolt it in place with angle-irons.



This tractor has not only paid for its transformation but is now earning its owner the funds to purchase the manufactured machine



Any motorist who has a used car can turn it into a tractor very cheaply if he will follow the ideas described in the story

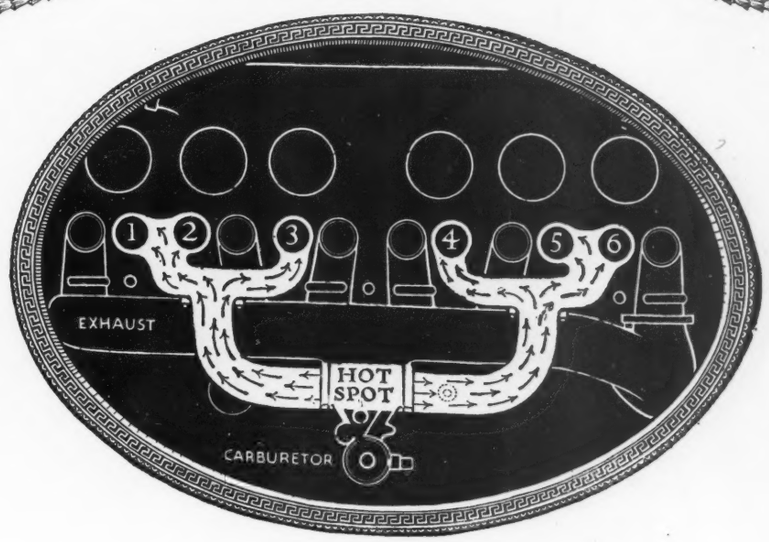
The gears and shafting can now be assembled. The small gears which are mounted on the automobile axle are 4½ in. in diameter; the large gears are 14 in. These dimensions need not be strictly followed so long as the ratio is kept 3½ to 1. The reduction between the sprockets is 4 to 1, the small one being 6 in. in diameter and the large one 24. Although ordinary pillow-blocks may be used for bearings, if they are made as dust-tight as possible by collars and leather washers at each end, a roller type anti-friction-bearing is preferable because of the saving of power.

The method of attaching the drive-wheel axle to the frame is shown in Fig. 3. The arrangement for adjusting the tension of the chains is also detailed in this figure. The driving-wheel hubs, if possible, should be machined to take roller bearings, but this is not absolutely necessary. A sheet-metal case to protect the gears from dust and oil-cups to keep them properly lubricated are improvements that can be added if desired.

The draw-bar is made of 2½-by-4 in. oak, and the braces of 2½-by-½-in. iron. Holes are bored in the draw-bar 4 in. apart to provide for different positions of the hitch-clevis.

With some makes of cars it will probably be possible to have a power take-off pully at the front, as shown. The bearing supports are bolted to the frame of the automobile and the shaft is coupled to the front end of the crank-shaft. In case the crank is required for starting, it can be fitted to the end ofthe shaft projecting beyond the pulley. The wheel-cleats are made from 2-by-2 in. L shaped iron. They are 9 inches long.

Popular Science Monthly is offering $50 in prizes to those who can tell the most novel uses for a hairpin. Read the conditions on page 128



Bringing Your Automobile Up-to-Date

SUPPOSE that your stove is intended to burn a shovel-full of pea coal an hour and then suppose that you suddenly filled it with lumps as big as your hand. What kind of a fire would you have?

Most automobile engines are like that stove. *They are intended to burn a certain kind of fuel, but only the wrong kind is available.*

What happens in a running engine? First a liquid fuel is vaporized by spraying it; then the spray is mixed with air to form an explosive; next that explosive is compressed in the engine; finally the charge is fired. All this takes place in the fraction of a second.

The fuels of today do not vaporize readily. They cannot be sprayed finely enough. *You want a kind of gasoline fog. Instead you get rain.* The gasoline accumulates in little pools. It finds its way into the cylinder and eventually into the crankcase and the lubricating oil. *Think of it—gasoline in lubricating oil!* No wonder that the engine knocks and that you have big repair bills to pay.

Now you see why automobile engines of today are like the stove that is intended to burn pea coal and is trying to burn big lumps. Why it is so hard to start and to get underway, particularly on a cool morning. Why you are not getting all the power that the engine is supposed to deliver.

The Chalmers engineers have been working at this problem for two years. *They decided that automobile engines of today were behind the gasoline times.* It was impossible to buy the right kind of gasoline cheaply enough. There was only one solution: Improve the engine so that all the gasoline will be consumed—so that not a raw drop of it will be fed to the engine.

Heat will vaporize these modern heavy fuels. That is why you must wait for your engine to "warm up." But the ordinary process is too slow, too wasteful. Besides it doesn't prevent drops of unconsumed gasoline from forming.

The Chalmers engineers make the exhaust heat of the engine vaporize any drop of gasoline that touches the walls of the manifold, before it ever has a chance to reach the engine. *Their's is the Hot Spot engine.*

But that is not all. The manifold—the passage that supplies the charge to the engine—is too angular in many multi-cylinder cars. The vapor is not fed uniformly to all cylinders. It strikes corners.

The Chalmers engineers gave us the Ram's-horn manifold. It has easy bends—no sharp turns. Hence the cylinders are all supplied with the same quantity of vapor.

The Hot-Spot Insures:

Quick starting.

Perfect operation in 30 seconds on the coldest day.

No raw gasoline in the crankcase to "cut" the lubricating oil.

A cool engine on a hot day.

The Ram's-horn Insures:

A smooth running engine.

All cylinders working all the time.

Reduced vibration and therefore lower upkeep cost.

CHALMERS · MOTOR · CO.
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This is the second of a series of six bulletins in which the wonderful features of the new Chalmers will be explained.

SHOOTS
Straight

Straight as a Streak of Light

IVER JOHNSON

A man's game—revolver shooting—and a man's need. Hand and arm relaxed for steadiness—cover the target—gentle contraction of thumb and trigger finger—and a hit. A week's practice makes you a fair shot.

The superbly rifled barrel of an Iver Johnson spins the bullet on a steady axis. It holds a true course—hits where the barrel points. A bullet scarred by poor rifling wabbles—end over end—hits everywhere.

The Iver Johnson is safe. It cannot be fired by accident. Its lightning power responds only to a trigger pull. No danger if dropped. You can "Hammer the Hammer."

Unbreakable coil springs never fail—today or in fifty years.

Which do you want to know about—Revolvers, Single- and Double-barrel Shot Guns, or Bicycles? Richly illustrated books free. Learn how to get highest value—quality backed by reputation—at basic cost. Address a post-card now.

IVER JOHNSON'S
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HAMMER THE HAMMER

Buy an Iver Johnson this Spring. Have fun; gain health; save money. Iver Johnson SUPERIOR ROADSTER, Price $50. Other models, $27.50 to $60.

Anyone Can Make This Postal Scale

TO those who have considerable correspondence, necessitating the frequent weighing of letters to determine the correct postage, and who do not wish to invest in a letter-scale, the illustration shows a simple and efficient scale that can be made at the expenditure of a few minutes' spare time.

Procure an old corset steel, break it in half, and fasten it to the edge of a wooden block about 2 in. square and 1 in. thick, using four tacks driven in at the sides of the steel to hold it in place. Then screw the block to the side of a desk, bookcase, or window-casing, and bend the steel so that it will slant upward to an angle of about 30 degrees. On the free end tie a spring

Fully as good as the similar office appliance sold is this postal scale

clip salvaged from an old pair of suspenders; or a paper-clip will do.

Paste a piece of cardboard under the free end of the steel, and mark the normal position as *O*. Then get a known weight of 1 ounce and suspend this from the steel, marking on the cardboard "1 ounce." Do the same thing with a 2-ounce weight; and in a similar manner locate the 3- and 4-ounce points.

The first weight may be borrowed from a local store, or made from a piece of solder wire, adjusting it to the proper weight on a pair of scales.

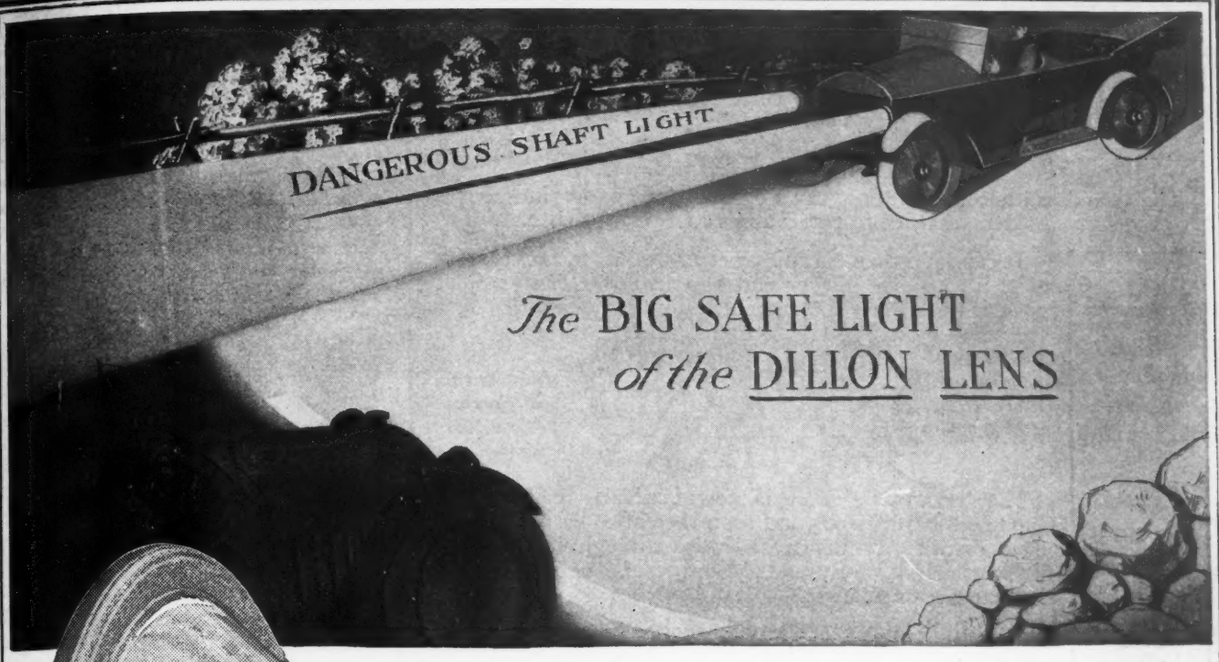
This scale should appeal especially to the small mail-order dealer who is just starting in business and who must make every dollar do the work of two.—V. H. TODD.

How to Erase Pencil Marks on Tracing Cloth

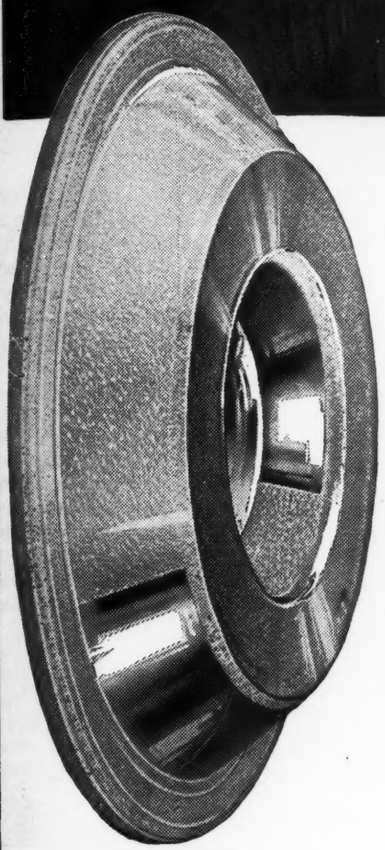
EVERYBODY knows that in making pencil erasures on tracing cloth, an ordinary rubber eraser leaves a smutty mark.

To overcome this, the writer secured an ordinary fountain-pen filler, filled it with gasoline, and attached a small rag at the end.

To make an erasure, he merely takes the filler and, pressing slightly on the bulb end, rubs with the rag, and the erasure is neatly made, with no blurry mark.—A. E. KIPPS.



The BIG SAFE LIGHT
of the DILLON LENS



Protect Yourself From the Other Fellow's Glare

When you ride in the great safe path of Dillon light the glare from the lamps of passing cars does not annoy or confuse you as it does when driving with ordinary headlights.

You notice it little more than you would in broad daylight.

This is due to Dillon efficiency in lighting the road in front and on both sides.

It successfully combats the time worn theory that your own safety depends more upon the other fellow's lights than your own.

When your headlights are efficient you not only see the whole roadway in daylight clearness without danger of confusing passing drivers, but you actually protect yourself against the other fellow's glare.

In minimizing this hazard the Dillon Lens adds an important element of safety to night driving.

Get a pair from your dealer today. Test them out under any or all conditions, and if not fully satisfied return them and your money will be refunded.

If your dealer can't supply you, write direct, same price, $3.50 per pair, any size, anywhere in the U. S. A.

DILLON LENS & MFG. CO., Dept. "B," Wheeling, W. Va.

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PITTSBURGH PLATE GLASS CO.

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$3.50 *per pair*
Any Size
Anywhere in U.S.A.

The Dillon Lens is the only lens with the magnifying bull's eye. It is the only lens sold with a money-back guarantee. It gives a big, glareless light on the road, at both sides and far ahead. Legal in all states.

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Helps Its Policyholders Safeguard Their Health

The ideal insurance institution can do much more for its policyholders than collect premiums and pay death claims.

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- Eyesight
- Spring Health-Hints
- Mouth Hygiene
- Pneumonia
- Value of Raw Food
- Child Mortality
- Grip
- Gateway of the Body
- Healthfulness
- Eyesight and Illumination
- Colds
- Science and Sense in Optics
- Health-Hints for Children
- How to treat the Eyes, etc., etc.

It can help them to enjoy better health, to prove more efficient, to live longer and happier; and that is just what is done for its policyholders by the

Resources more than $9,000,000.

POSTAL LIFE INSURANCE COMPANY

Insurance in Force $40,000,000.

The "POSTAL", as it is now familiarly called, was chartered in June 1905 and soon thereafter began rendering a distinct co-operative service through its POLICYHOLDERS' HEALTH BUREAU. Some of the features of the BUREAU are as follows:

Health Bulletins: A valued privilege extended by the BUREAU consists of practical Health Bulletins, prepared under scientific guidance, and presenting in simple language dependable information regarding disease-prevention.

Correspondence: Policyholders are privileged to correspond with the HEALTH BUREAU regarding matters of personal hygiene and health-preservation and advice is given which is timely and helpful.

Annual Examinations: Policyholders are entitled, under certain liberal conditions, to the privilege of one free medical examination, each year, if desired, so as to detect disease in time to check it.

Statistical Service: The Company receives and studies published statistics on Health Conservation in the interest of policyholders. It thus supplies a leaven helpful to the public health in many communities.

It will thus be seen that the POSTAL LIFE is not only the company of ***safety*** and ***saving*** but also of ***service***—real, co-operative service, of distinct, immediate advantage to its policyholders and the general public.

Full Information Sent On Request

To learn more in detail just how the POSTAL serves its policyholders, along health-lines, write for the company's free Booklet, "POLICYHOLDERS' HEALTH BUREAU", and a Bulletin on any particular subject mentioned at the left.

To find out what you can save on any form of policy, simply mention POPULAR SCIENCE MONTHLY for June and give

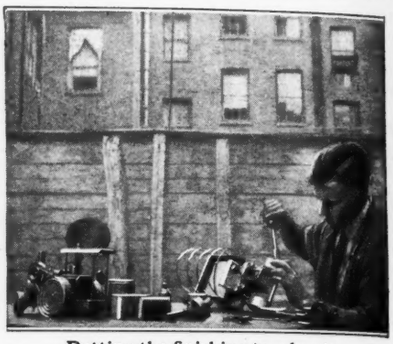
(a) Your *exact date of birth*, and
(b) Your *occupation*.

No agent will be sent to visit you. The Company will send you full information—*by mail only*.

Postal Life Insurance Company
Wm. R. Malone, President
511 Fifth Avenue, cor. 43rd Street
New York City

The Old Tin Can Comes into Its Own

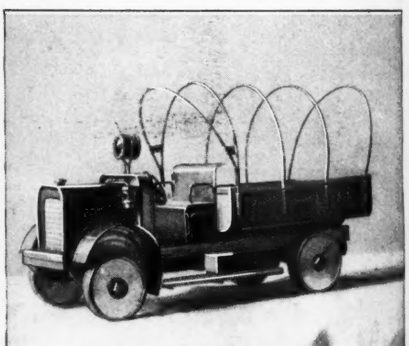
A NEW fad, that of making useful objects out of old tin cans, is attracting a good deal of attention these days. It originated in United States hospitals where shell-shocked men, who can stand hardly any sort of noise, devote their time to the manufacture of these toys. The men seem perfectly contented and happy in doing the work, for it makes them forget their afflictions temporarily. In fact, the doctors are advocating mental work for many shell-shock cases.



Putting the finishing touches to an automobile made of tin cans

Any number of useful objects can be made from the discarded can—candle-sticks, book-ends, match-boxes, flower-pots—and repair work on everything from watches to water-pipes.

The photographs herewith show a nearly completed toy automobile and the finished article, made entirely from tin cans. The bottom and sides are made from an oil-tin. The radiator is made of another tin, with a few holes punched in it and some slits on the sides that make it very realistic. A cap from a tooth-paste tube soldered in place forms the radiator-cap. The wheels are pressed-in lids from fruit cans. The tool-box is made from a tin marshmallow candy can, and the various other tin cans make up the rest of this unique construction.



All kinds of tin cans, even a tooth-paste tube, went into this toy

Some of you fellows who are laid up sick ought to try making some of these contrivances. You will feel better after putting something of this sort together. It will take your mind away from your ills and consequently aid the doctor in curing you.

BOOKS ON FLYING

Building and Flying an Aeroplane—A practical handbook covering the design, construction and operation of aeroplanes and gliders. Cloth 150 pages. 50 illustrations, **Price, $1.00 postpaid,**

Harper's Aircraft Book—Why aeroplanes fly, how to make models, and all about aircraft little and big. It explains in a simple, lucid manner the principles and mechanism involved in human flight, and tells how to design and construct model aeroplanes, gliders, and man-carrying machines. 245 pages. Illustrated. **Price $1.10 Postpaid.**

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York, N. Y.

Books for Mechanics

Sheet Metal Work—A manual of practical self-instruction in the art of pattern drafting and construction work in light and heavy-gauge metal, including skylights and roofing, cornice work, etc. Cloth, 288 pages, 370 illustrations. *Price*, $2.00, *Postpaid.*

Machine Shop Work—A comprehensive guide to the most approved methods in modern shop practice, the construction and use of improved tools and machines, hand tools, the lathe and lathe tools, the methods of screw cutting, taper and eccentric turning, etc. Leather, 275 pages, 325 illustrations. *Price*, $1.75, *Postpaid.*

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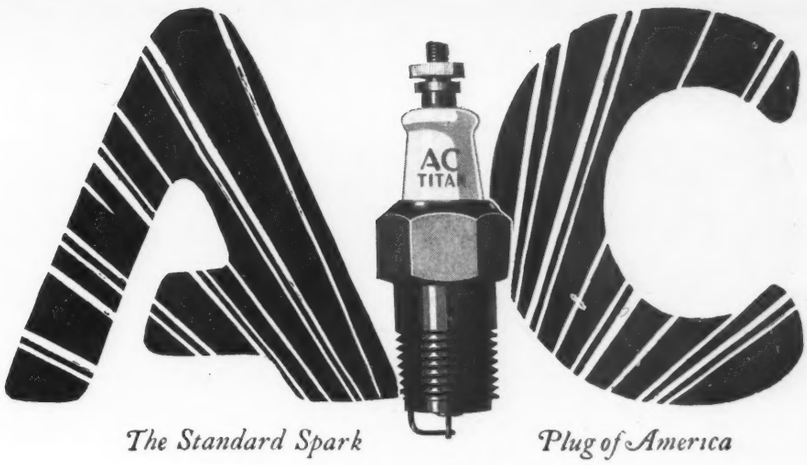
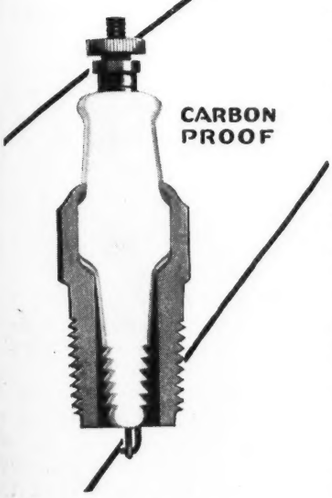


The Standard Spark Plug of America

Put an End to Your Spark Plug Troubles

Install a Complete Set of AC Carbon Proof Spark Plugs and See How They Improve the Performance of Your Car



Notice the sharp knife-edged porcelain in the cross section of the AC Carbon Proof Plug here illustrated. That construction is the whole secret of this plug's success. These edges, being thin, heat rapidly. The heat burns off the carbon as fast as it forms. This is an exclusive AC design and fully covered by our patents.

Here is the spark plug you have been looking for—the AC Carbon Proof, for tractors, Fords, Overlands and Studebakers.

Put a set of these plugs in your motor and save gasoline, better its performance, get more power.

For AC Carbon Proof Plugs are spark plugs with the trouble removed.

They do not short circuit easily. They always deliver a big, hot spark. They are well insulated with finest porcelain that heat will not crack, that vibration will not break.

These plugs permit a full advance of the spark without that old, familiar engine knock. After you have installed them you notice immediate improvement in your car's performance. For you get higher engine speed with a smaller throttle opening than before.

That means a big saving in your gasoline bill.

More power, no carbon, better performance, gasoline saved. Those are the advantages that AC Carbon Proof Plugs bring to you and they cost no more than the ordinary kind.

AC Carbon Proof Plugs are specially designed for tractors, Ford, Overland and Studebaker cars.

But no matter what car you drive there is an AC designed for it.

As you know well, most makers of fine cars use AC Spark Plugs for standard factory equipment.

And Government engineers during the war selected AC Spark Plugs of the same basic design as the plugs that these manufacturers have been using for years, as standard equipment on all Liberty and Hispano-Suiza Airplane Motors.

The spark plugs which served best in such emergencies can be counted upon to serve you best also.

Write for The Spark Plug Story. It contains information of much value to you.

Champion Ignition Company, FLINT, *Michigan*

These manufacturers use AC Spark Plugs for factory equipment

Acme Trucks	Deere Tractors	Jackson	Nelson	Saxon
Advance-Rumely Tractors	Delco-Light	Jordan	Nelson & Le Moon Trucks	Scripps-Booth
Ahrens Fox Fire Trucks	Diamond T Trucks	Jumbo Trucks	Netco Trucks	Scripps Motors
American-La France	Diehl Trucks	Kissel Kar	Northway	Seagrave Fire Trucks
Anderson	Dodge Brothers	Klemm Trucks	Oakland	Seneca
Apperson	Dort	Kleiber Trucks	Old Reliable Trucks	Signal Trucks
Appleton Tractors	Duesenberg Motors	Knox Tractors	Oldsmobile	Singer
Avery Tractors	Eagle Tractors	La Crosse Tractors	Packard	Smith Motor Wheel
Brockway Trucks	Essex	Lalley-Light	Paige	Standard Truck
Buffalo Motors	Federal Trucks	Lane Trucks	Pan-American	Stearns-Knight
Bugatti	F-W-D Trucks	Liberty	Paterson	Sterling Motors
Buick	Gabriel Trucks	Liberty Aircraft Motors	Patriot Trucks	Sterling Trucks
Cadillac	Genco Light	Locomobile	Peerless	Stewart Trucks
J. I. Case T. M. Co.	G. B. S. Motors	Marmon	Phianna	Straubel Engines
Chalmers	G. M. C. Trucks	Master Trucks	Pierce-Arrow	Stutz
Chandler	Gramm-Bernstein Trucks	Maxim Fire Trucks	Pilot	Sullivan Trucks
Chevrolet	Hall Trucks	Maytag	Premier	Swartz Lighting Plants
Chicago Trucks	Harvey Trucks	McLaughlin (Canada)	Reo	Titan Trucks
Cole	Hatfield	Menominee Trucks	Riker Trucks	Tower Trucks
Commonwealth	Haynes	Midland Trucks	Robinson Fire Trucks	United States Motor Trucks
Continental Motors	Herschell-Spillman	Mitchell	Rock Falls	Vim Trucks
Crane Simplex	Hispano-Suiza	Moline-Knight	Rowe Trucks	Ward La France Trucks
Daniels	Howell Tractors	Moreland Trucks	Rutenber Motors	Westcott
Davis	Hudson	Nash	Samson Tractors	White
	Hupmobile	National	Sandow Trucks	Wilcox Trux
				Wisconsin Motors

U. S. Pat. No 1,135,727, April 13, 1915, U. S. Pat. No. 1,216,139, Feb. 13, 1917, Other Patents Pending.

DU PONT AMERICAN INDUSTRIES

Learn to Shoot

Be friends with a gun! Know how to handle and use one! Not merely for protection but for the good health it will bring you. An hour or two every week at

Trapshooting

will help take worries from your mind and kinks out of your muscles. Oxygen and recreative exercise, mental and muscular, is the best tonic in the world for men and women. Your local gun club is the place to get both.

Write for name of nearest club and our book "The Sport Alluring."

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Smokeless Shotgun Powders

leaders for over a century, are the first choice of the Nation's crack shots.

Look on the shell box for the names

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Visit Du Pont Trapshooting School, Atlantic City, N. J.

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Directions for Making an Automatic Cigarette-Box

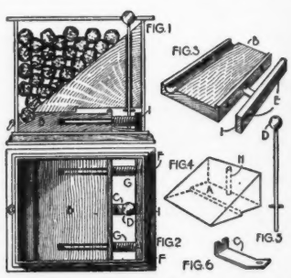
FIRST, a square box is built about 3 in. in height and 4 in. square on the sides. The bottom of the box will contain a small drawer which is grooved to a sufficient depth to hold one cigarette, as shown at *B* in Fig. 1.

A hole is drilled through the lid of the box to accommodate the small rod with

Push a button and one cigarette is served to you at a time. The box is easily refillable

the ball fastened on one end. This rod passes through the block, and is fastened with a small pin, which prevents the rod from being displaced. The spring, which holds the drawer until the ball is pressed, is made as shown in Fig. 6.

A small box is glued to the base of the square box, to which this spring is



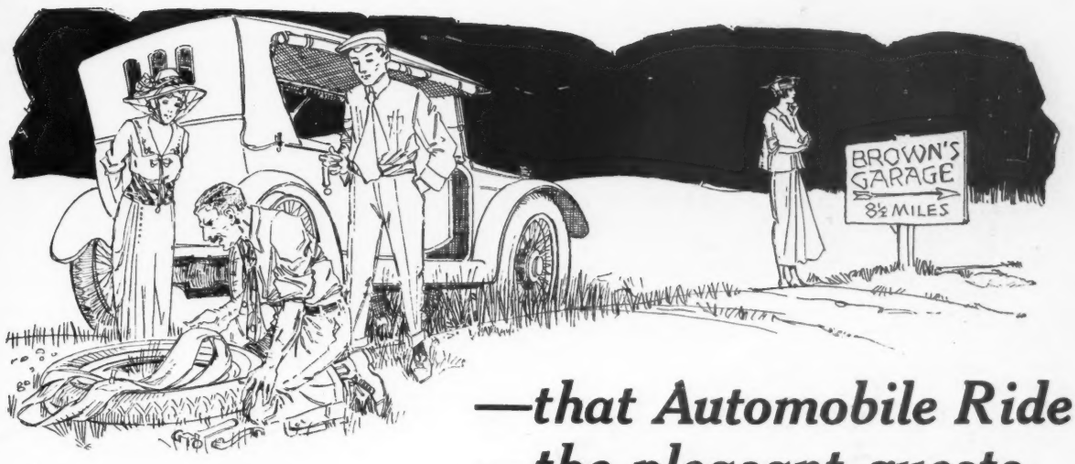
How the cigarettes fall down into the groove; and the construction of the box

screwed in the middle, as shown in Fig. 3. Two holes are also drilled to allow for two nails, from which small spiral springs are placed; these, when the ball is pressed, force open the drawer containing the cigarette.

The drawer itself has a projection in the rear to keep it from leaving the pocket; the wood block *A* has a corresponding space grooved out which acts as a stop for the drawer. The following is a list of the various parts needed: Wood block, drawer, spring steel, holder for nails, ball on rod, nails, spiral springs, hole in block to pass rods through, block to hold springs and nails.

When the parts are properly assembled the following action will take place.

The opening in the top of the box is, of course, filled with cigarettes. On pressing the small ball the drawer will be forced outward by the two springs, delivering one cigarette at a time.—HENRI MARCELLE.



$2.00

would have saved you all that

—that Automobile Ride
—the pleasant guests
—the hot dusty road
—and then the puncture
with the delay, dirt, worry and work.

What many autoists believed impossible has been accomplished. Tires *can* be made *Puncture Proof* and *Leak Proof.*

Diagram showing the action of Kor-Ker.

The first outrush of the strong air pressure forces Kor-Ker into the aperture where the moisture is automatically removed.

Kor-Ker is compressed into a cement plug and becomes an integral part of the tube.

The inner tube can be removed from one casing to another. Kor-Ker does not cement the inner tube to casing. Does not interfere with the valve stem.

Driving Nail into Tire Treated with Kor-Ker Puncture Cure. This is the strongest proof any one can ask and will convince the most skeptical.

For ***seven years*** and in ***forty different countries*** thousands of autoists have been enjoying the luxury of riding free from the worry or care of punctures by treating their tires with Kor-Ker.

Drivers to their amazement and delight have found that they could forget their tires after they were Kor-Kerized.

Price, $2.00, $2.50, $3.50 per box. One box equips one tire.

KOR-KER removes the bugbear of automobiling.

KOR-KER instantly and permanently seals punctures.

KOR-KER stops slow leaks—makes tires non-porous.

KOR-KER often gives 50% more mileage.

KOR-KER keeps tires at normal inflation — no broken sidewalls, rim cuts, chafed beads, etc.

KOR-KER reduces possibility of blowouts to a minimum.

KOR-KER saves many dollars a season.

KOR-KER saves you the delay and bother of a puncture on the road.

There's likely to be a KOR-KER representative in your town. He'll demonstrate the merits of KOR-KER to your complete satisfaction in a few minutes.

If you don't know the KOR-KER man write us for his address. We will send you a mighty interesting booklet.

ALCEMO MFG. CO., 136 Bridge St., Newark, N. J.
Send me your booklet on "Care of Tires."
Name .....
Address .....

ALCEMO MFG. CO., Newark, N. J.

A Dandy on the Hills

Boys who live in the country are particularly fond of this husky Indian bicycle. It runs so smoothly that it makes sandy roads and hills a cinch.

The pitch of the front forks and the comfortable handlebars and saddle make it so easy to control that it's no trick at all to ride the narrowest path.

Several models at varying prices are carried in stock by Indian Motorcycle dealers. Send us your name and address and we will mail you a beautifully illustrated catalog and the name and address of the nearest Indian dealer.

HENDEE MANUFACTURING CO.

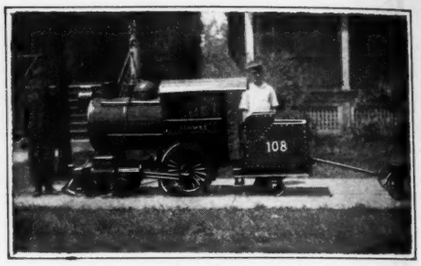
Springfield, Mass.

Indian Motobike

A Miniature Locomotive Made in Odd Moments

THE boys who live in the vicinity of Irving Stone, of Chicago, never find life dull, because his one-boy power locomotive is a perennial source of entertainment. The engine, which was made by the young owner's father from things that were "around the house," is powerful enough to draw two wagons and four passengers as a medium load, and three wagons and six boys in case of emergency. The eight-year-old engineer, shown in his cab, uses pedals to supply the power exactly as with a bicycle.

The engine, as may be seen from the photograph, is a substantial affair. It weighs about 125 pounds, has a length of eight feet, and is four feet high. It has ball bearings throughout, a pair of brakes that will lock the drivers and bring the engine to a dead stop in its own length, a steering apparatus that



Small—yes; but it has all the contrivances of a regular locomotive

enables the engineer to run it backward as well as forward, and a deep four-tone whistle to warn automobilists out of the way.

Fully as interesting as the finished locomotive is the method of construction. Mr. Stone worked at it in odd times for three years, using for the most part scraps picked up here and there. A discarded paint-can serves for the stack, and a copper float from a tank for the dome. A two-quart can, with the cover pressed in, is the foundation of the headlight, while the upper part is a cocoa-can and the lower part a quart can of the kind used to hold the paint for screen doors. The manhole cover is the top of an old garbage-can. Two ordinary tin cans serve for the air-pumps—on the opposite side of the engine from that shown in the photograph.

The impressive-looking boiler is simply a container in which fertilizer is sold in hundred-pound lots. The cab is built around a wooden frame, and covered with a piece of sheet-iron recovered from a junk-shop.

The heavy drive wheels are built over and about the wheels from a discarded baby-carriage; the fifty-four pieces of wood in each are skilfully fitted into the original metal framework.

Though the locomotive looks rather heavy, it is so well constructed that the eight-year-old owner is able to operate it with ease.—FRED TELFORD.

Ride a Motorcycle

United States Cycle Tires are Good Tires

WHICH is the better way to get home from work—to pack into a crowded trolley car, or to get out into the clean, open air?

Only one answer to that, isn't there?

Boys and men who use motorcycles for business always know the advantage of good tires. They want United States Tires because they are always dependable. No unnecessary time is lost in repairs. They wear longer and are more economical.

United States Tires are made by the world's largest rubber manufacturer and every tire carries the U. S. Seal which means quality in rubber goods wherever you see it.

The 'Usco' Motorcycle Tire is the tire to use for long mileage and hard work. Ask to see it at any United States dealer's.

GRAFLEX

The camera that does the difficult things in photography—and does them well.

It's raining as the ship you have come to welcome home is warping into the dock; the automobile racers are going by your point of vantage at a hundred miles an hour; a quick snap of the ball from pitcher's box to "first" has caught the runner napping; the children are romping at play on the half shaded porch—impossible pictures for most cameras, but simple with a Graflex.

The Graflex catalogue—free at your dealer's or by mail—tells you why.

FOLMER & SCHWING DEPARTMENT
EASTMAN KODAK CO. ROCHESTER, N. Y.

How to Make Water Run Uphill

A TWELVE-YEAR-OLD boy at Yakima, Washington, overheard his parents talking of the need of utilizing every vacant space in the production of food crops, and he asked permission to cultivate a lot adjoining the family residence. "Certainly," his dad replied, "but the ditch is too low. It can't be done."

The word "can't" wasn't in that boy's lexicon. Without asking help from any one, he collected his materials—a big tin pan, a slab of wood, a bicycle wheel, a few small tin cans, and some discarded gutter-pipe. He placed a sluice-box gate in the irrigation

This miniature "River of Doubt" was conceived by a lad of twelve years

stream, and built the water-lifter shown in the illustration, utilizing the power of the stream and supplying a steady stream of water to his thirsty land.

The boy's garden blossomed as the rose and was the pride and envy of all the neighbor lads.

In a larger way, utilizing the principle of the boy's invention, many adult farmers of the neighborhood are preparing to grow useful crops by irrigating land that hitherto has grown only weeds.

Exactly the same trouble exists in the great valley of Des Chutes in Oregon, where the swift river flows through the entire length of the valley at the bottom of a rock-walled canyon hundreds of feet deep, while millions of acres of fine land on the plains above are practically worthless because of the lack of water. The engineering need is some practical plan of lifting water from the river.

A Future Engineer?

This problem was the despair of the late James J. Hill. Perhaps the problem will be solved when the lad in Yakima grows up. At any rate, this successful attempt at irrigation proves that "the child is father to the man," and also that a boy's foresight in problems of this sort sometimes gives engineers ideas for successful gigantic construction work.—PHIL NORTON.

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Save Laundry Bills

For Men in Every Walk of Life

Here's the collar that saves time and money—won't wilt and always looks neat.

Challenge Cleanable Collars

give you all the style, snap and comfort of Cotton Collars with the added advantage of being instantly cleaned when soiled. 35c each at your dealers or direct—state your size and style. Booklet on request.

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Whatever your pencil needs—the ELDORADO will *ease* and *quicken* your work. Long wearing, delightfully smooth leads, strong, responsive and even in tone.

Made in 17 LEADS one for every need or preference

Get a trial dozen, or send for our grade chart, enclosing 15c. if you wish full length samples worth double the money. Please mention your dealer's name and whether very soft, soft, medium hard or very hard lead is desired.

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Canadian distributors
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There is a Dixon quality Pencil, Crayon, and Eraser for every purpose

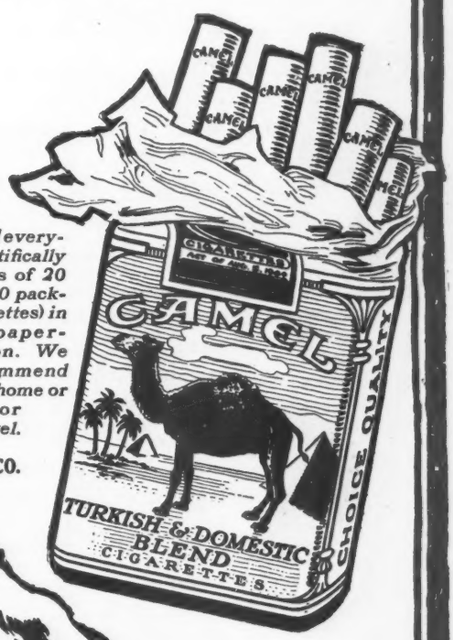
YOU will prefer Camel cigarettes expert blend of choice Turkish and choice Domestic tobaccos to either kind smoked straight.

Camels quickly capture your favor because they are made to meet your taste! You start right in on Camels as though you had been smoking and enjoying them for a year! They're a revelation—they're so appetizing, so refreshing!

Camels have won their way readily because the expert blend makes possible to cigarette smokers such unusual satisfaction. The blend also accounts for Camels desirable "full-bodied" mellowness and their freedom from any unpleasant cigaretty aftertaste or unpleasant cigaretty odor.

And, never fear of Camels tiring your taste! That flavor and fragrance become more thoroughly enjoyable all the time!

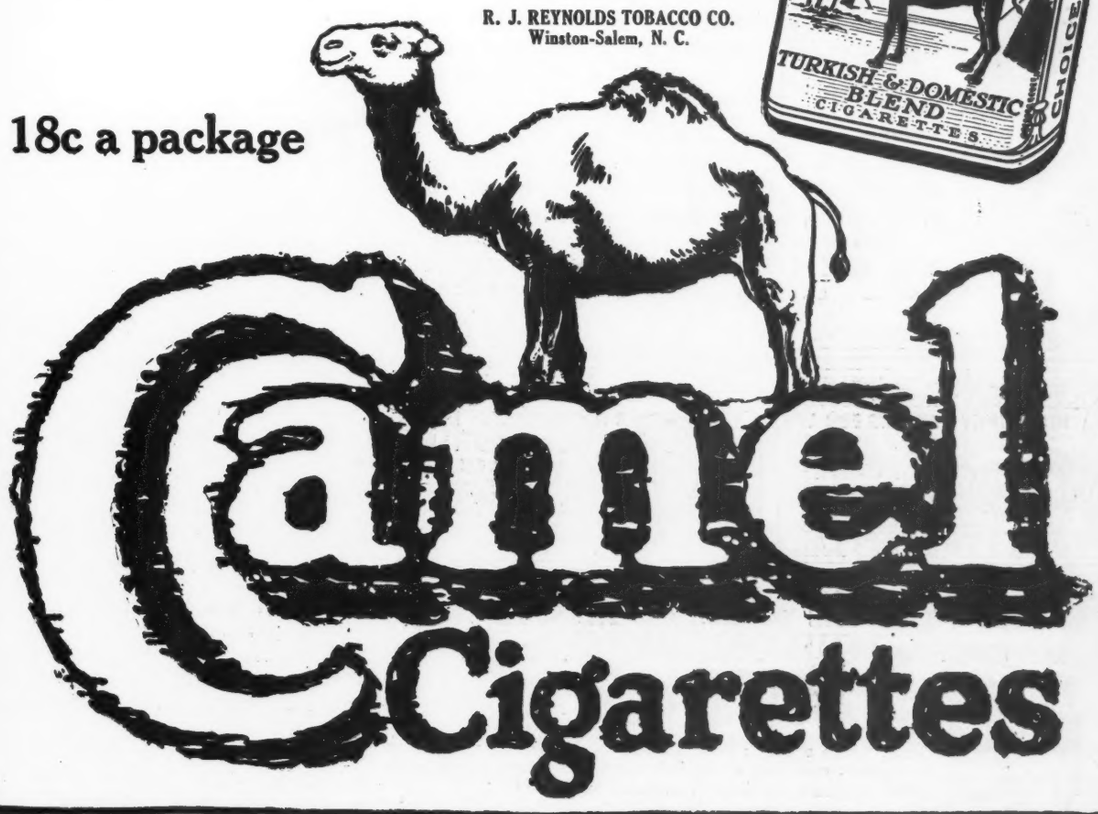
So confident are we that you will like Camels that we ask you to compare them with any cigarette in the world at any price!



Camels are sold everywhere in scientifically sealed packages of 20 cigarettes, or 10 packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for home or office supply or when you travel.

R. J. REYNOLDS TOBACCO CO.
Winston-Salem, N. C.

18c a package



WDC TRADE MARK

WDC
TRIANGLE
THE GENUINE BAKELITE
Reg U.S. Pat Off.

FOR men who want a distinctive kind of bit we make the W D C Triangle pipe—a W D C pipe with a mouthpiece of genuine Bakelite.

Bakelite has the beautiful amber color and possesses a rich lustrous transparency and an unequalled brilliancy.

For pipe stems, cigar and cigarette holders there is no better substance known to science than Bakelite. It has all the advantages of natural amber, but none of its failings. It is tasteless, odorless and non-inflammable. Then, too, it is more durable than amber.

Like all pipes bearing the W D C trade mark the bowls of W D C Triangle pipes are genuine French briar, specially Demuth seasoned and guaranteed against cracking or burning through.

All good dealers can show you some distinctive shapes in W D C Triangle pipes at $1.00 and up. Also cigar holders at 50c and up, and cigarette holders at 35c and up, in many distinctive styles.

WM. DEMUTH & CO., NEW YORK
WORLD'S LARGEST PIPE MANUFACTURERS

DENINGER WILL SAVE YOU $40
BIG MONEY SAVINGS FOR YOU
Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.
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YOU 25 TO 50 DOLLARS

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BRUSHES
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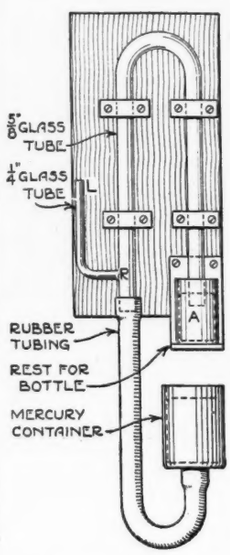
Brush Manufacturers for Over 108 Years and the Largest in the World

How to Make a Mercury Vacuum-Pump

THE following is a description of a mercury pump that will be found very useful for the experimenter's laboratory.

To make this pump, get a piece of $\frac{3}{8}$-in. glass tube 20 in. long, and bend it in the usual manner, making it U-shape. Heat this tube about 1 in. from one of the ends, hot enough so that $\frac{1}{4}$ in. of the tube in the shape shown can be forced through. A container for the mercury is attached to the end of the U-tube with a heavy rubber tube about $1\frac{1}{2}$ in. long. The other end is immersed in a bottle containing mercury. The U-tube should be mounted on a board, as shown.

To operate the pump, connect the article to be exhausted at *L*. As the mercury-container is lifted the mercury in the tube will rise, closing the opening *R* and forcing the air in the tube out at *A*. Because of the partial vacuum formed, the mercury in the bottle will rise in the tube, and thereby prevent air from coming back into the tube. By lowering the mercury-container the opening at *R* will again be left open to let in a new supply of air.



Here's an easily made pump that will do the work of the store article

The degree of vacuum obtained in the article being exhausted will depend on the number of times the mercury-container is raised and lowered.—C. S. CIERPIK.

Easily Distinguished Marks for Drafting-Pencils

A DRAFTSMAN who is using several pencils of different grades for different classes of work on the same drawing is often delayed by having to pick up each pencil and look at the number on it until he finds the right one.

Distinguishing marks by which each pencil can be readily told at a glance may be easily put on with ordinary drawing inks. For example, two black lines around the top might indicate the 2H, while the 5H would have five similar lines.

Different-colored inks, or various positions of the lines along the length of the pencil, denote the several letters that are used in grading drawing pencils.—G. M. MORRISON.

Let the Dayton Help you "Play".

Dayton Bicycles

Young and old—everybody must "play" a part of the time!

After work, on Sundays and holidays! That's the time for "play"! And nothing can add as much to these short hours as a Dayton Bicycle!

It will take you to the baseball diamond, the tennis court, golf links, fishing hole, and swimming hole quick as a wink. It gives you more time for "play"—and in itself is pleasure and recreation!

Let a Dayton Bicycle help you "play". You will be proud of it in any company —for it is certainly good-looking!

All Dayton nickel-plating goes on over a heavy coat of copper.

The enameled surfaces, as you see them, represent, in all, some 17 processes—beginning with a bath in boiling lye and ending with the coat of varnish which completes the job.

Between these two operations are the anti-rust and filler coats, the rubbings, washing and bakings —and two coats of the famous Dayton Carmine! The Dayton finish retains its lustre and brilliance. It wears, and wears and wears.

See the Dayton Line at your dealer's. Study the mechanical superiorities pointed out below. Our catalog describes and pictures the Dayton Line completely. It is free.

Write today for Catalog B-10.

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We Back This Trade-Mark With Our Reputation

1 One-piece drop-forged cranks. Hobbed sprockets.

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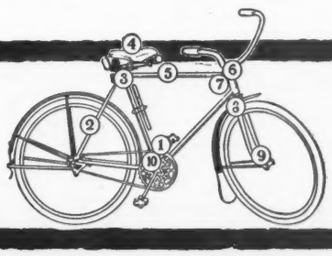
4 High-grade padded leather saddle with double action springs. Leather tool bag and complete tool equipment.

5 Seventeen process enamel finish of Dayton Carmine. Tough and long wearing. Heavy coat of copper under all nickel plating.



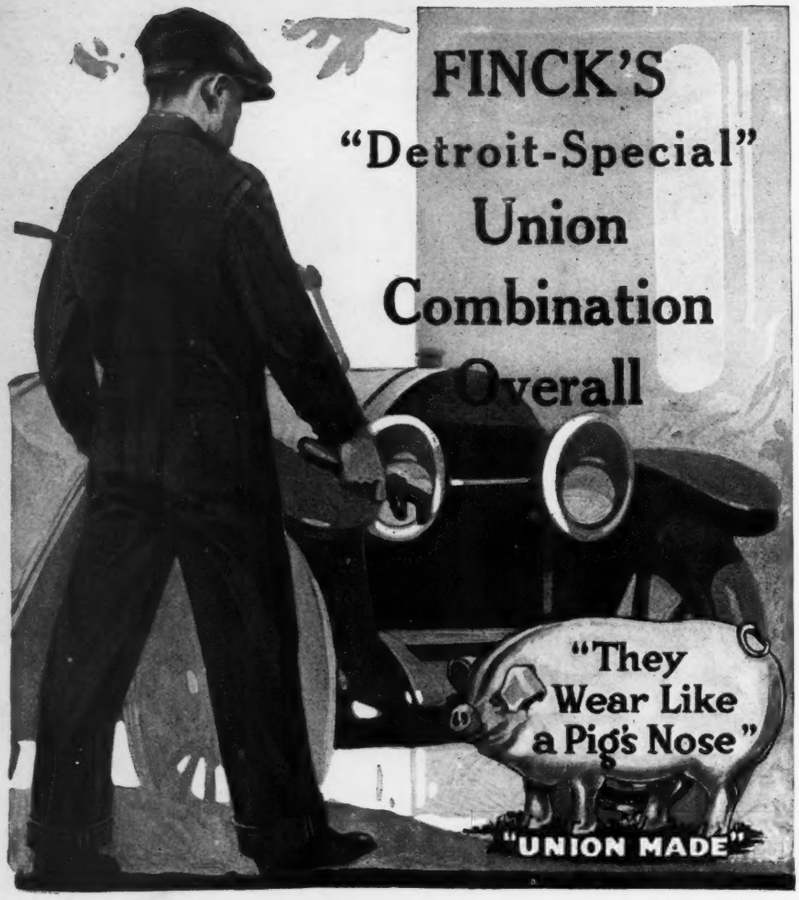
6 Dust-proof head adjusting cone. Extra large High Duty ball bearings. Cones case-hardened in cyanide.

7 Outside joint-head construction. Eleven inner reinforcements in frame, all dip-brazed.

8 Double anchored fork sides with solid steel spool between plates.

9 Front hub and cups of special design turned from solid steel bar. Two-point frictionless bearings.

10 Seamless crank hanger bracket, extra reinforced.



If you have never worn one, buy at your nearest dealer. If he cannot supply you, send your breast and leg measurement and your dealer's name, and a suit will be sent to your dealer for you—returnable if not satisfactory. We will also mail you a catalog.

You will be pleased, like 2,000,000 other wearers, with the fit, comfort, convenience and long wear it gives.

The coolest work-garment for summer wear

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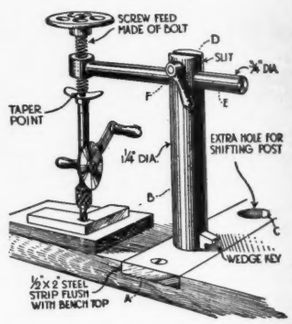
THE SPRAGUE PUB. CO.
28 American Bldg., Detroit, Mich.

A Practical Bench Drill-Post for the Work-Shop

THIS home-made bench drill-post is one of the best tools that I have ever made for the work-shop. Anyone who is handy with tools can make it. The sketch shows quite plainly how it is constructed and used. A piece of ½x2-in. bar stock, *A*, either steel or iron, is drilled and fitted to take the round post *B*, each hole having a taper keyway *C* cut or filed in it.

This piece of stock is then set into the bench flush with the top of the plank. (I obtained an old wagon-wheel tire to make this bar.) The upright round post is drilled and the end split, as indicated at *D*, to take the movable arm *E*, the securing screw and clamp *F* binding it. The end of the arm is heated and upset to form the boss, into which a feed-screw is placed,



Drill work is greatly facilitated by the use of this home-made drill-post

the screw being a common ⅝-in. bolt, a small hand wheel being used to turn it.

A taper key is employed to wedge the device at any desired position and height. A blow on the key-head tightens it, while a pry with a pinch-bar under the head loosens the rig. The feed-screw can be turned to feed in any angle by releasing the clamp of the arm at *F*, which permits it to be turned. So flexible is this rig that any sort of work can be easily drilled with it.

Extra holes in the bar set in the bench permit of its being shifted back and forth along the length of the bench, and by placing it in a hole at the end of the bench it can be swung in position for use in drilling bulky work on the floor.

A drill-post of this kind can be adapted to almost any kind of woodwork, and its advantage over the breast-drill is easily seen, as it combines a number of operations and gives a clean and straight hole to all kinds of wood.

Those who contemplate constructing this tool will find that it requires only a minimum amount of labor and costs practically nothing, as the material may be picked up in any junk-shop at little cost. It will do all the work of the manufactured article.

—CHARLES H. WILLEY.

Tuxedo

The Perfect Tobacco for Pipe and Cigarette

Finest Burley Tobacco
Mellow-aged till perfect
+ a dash of *Chocolate*

"Your Nose Knows"

The New "Tea-Foil" Package

is the most popular innovation of many years in smoking tobacco packages. Smokers are delighted with its many advantages. Handier—fits the pocket. No digging the tobacco out with the fingers. Keeps the pure fragrance of Tuxedo to the last pipeful. Not quite as much tobacco as in the tin, *but*—

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RIZ LA+.—the lightest, thinnest, finest strongest cigarette papers in all the world. Roll a Tuxedo cigarette with RIZ LA CROIX.

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The American Tobacco Co.
INCORPORATED

You Can Make Your Writing *T-a-l-k!*

Just as oratory puts the power of emphasis into the *spoken word*, so the—

MULTIPLEX HAMMOND
Standard Writing Machine

—puts the all-telling power of emphasis into the *written word*.

No other typewriter

turns cold type into **living, breathing words**—words pulsating with the writer's deepest convictions—words expressing to a nicety his most conventional mood—words showing always absolute correctness—**in business, professional or social usage.**

The business man

who uses the Multiplex can put character and individuality into his letter, and can emphasize the important parts by **changing instantly** from one style of type to another. "*Just turn the knob*"—and change!

Note the five distinctly different type-styles reproduced in this advertisement.

The lawyer who swayed

judge and jury by his eloquence can write his **brief** on the Multiplex so that **every telling point scores with the judge.**

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can prepare his manuscript so that no climax or no subtle point will be lost—**can see his story practically in print** before it goes to the publisher.

The Multiplex is unlike any other typewriter

It is revolutionizing typewriting. Its work is as great an improvement over the typewriter as the earlier typewriter was over the fountain pen, or the fountain pen over the quill. Just think of being able to choose from over 365 different type-sets, including all languages!

Mail the Coupon for FREE BOOKLET

It will show you how, with the Multiplex, you can put the force of emphasis into your typed matter—how you can drive home with strength of accent the fullness of your argument—how you can write with the same convincing force that you use in speaking—an **exclusive feature** of the Multiplex.

We will also send our pamphlet, **"The President and His Typewriter."**

Also—an Aluminum PORTABLE Model

For Traveling—for Home. Weighs about 11 lbs. Full capacity. Ask for special folder.

Write your name, address and occupation below and mail to—

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Dollars in Hares

We pay $7.00 a pair and express charges. **BIG PROFITS.** We furnish guaranteed high grade stock and buy all you raise. Use back yard, barn, cellar, attic. Contract and booklet free.

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Chemical Tricks for Boys

Puzzle your friends with mysterious, harmless Chemical tricks. Pour red, white and blue from a glass of water; write secret letters with invisible ink; write with water and have it turn blue; make your own blue ink or ink powder. You can do these tricks with "CHEMCRAFT" Junior. Send for your outfit rightaway and get a Free copy of "The Chemcraft Chemist."

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THE PORTER CHEMICAL CO.
Industrial Arcade
Hagerstown, Md.

CHEMCRAFT JUNIOR 25¢ POSTPAID

Rules for Building an Irrigation-Ditch

SOME engineering principles must be observed in the construction of satisfactory irrigation canals, but the farmer may build his own ditches by following a few simple rules. Head ditches and canals are often made on too steep a grade, so the excessive velocity causes scouring of the material in which they are built. The capacity of a ditch depends upon the grade desired or available and on its size. Lesser factors are the roughness and shape of the section.

The table illustrated gives the flow in cubic feet per second of the streams that may be carried by the earthern ditches of the size, grade, and shape indicated. The velocity is also given, since this must not be too great for the material traversed. The maximum safe velocities are:

For very fine soil, 1 ft. per second.

For ordinary loamy soil, 2 ft. 5 in. per second.

For very stiff clay soil, 4 ft. per second.

VELOCITIES & DISCHARGES OF EARTH DITCHES
VEL.=VELOCITY OF FULL STREAM IN FT. PER SEC.
DIS.=DISCHARGE OF FULL DITCH IN CU. FT. PER SEC

T	B	D	AREA	FALL OR GRADE PER 100 FT. OF DITCH.								ALL-CUT EXCAVATION PER MILE
				0.5"		1.0"		1.5"		2.0"		
FT.	FT.	FT.	SQ.FT.	VEL.	DIS.	VEL.	DIS.	VEL.	DIS.	VEL.	DIS.	
1.5	1	0.5	0.625	.52	.32	.73	.47	.94	.59	1.08	.68	120 CU.FT.
3.0	2	1.0	2.50	.75	1.89	1.07	2.67	1.33	3.34	1.54	3.85	490 " "
4.5	3	1.5	5.62	1.04	5.82	1.47	8.28	1.84	10.31	2.11	11.88	1100 " "

A little study of the above table and care in construction will result in an efficient irrigation tract

It will be much easier to turn water out of field laterals if they are carefully located with a fall of only 2 in. per 100 ft., or, if they are to carry larger streams, 3 in. per 100 ft.

The illustration shows a simple ditch level designed by the writer. A selected piece of lumber is fitted with a slotted strap of iron, as shown, and a lock-nut to clamp it in the groove with its foot projecting from the bottom of the board. An adjustable level tube that may be purchased for a dollar is fitted into the mortise in the upper edge near the clamp. The level board is 12½ ft. long, so pegs that distance apart may be set to any desired grade by clamping the foot with a projection of ⅛ in. for each inch fall desired per 100 ft. of ditch. As an example of the use of the high grade-level, assume that we wish to convey a stream of 8 cubic ft. of water per second in an earthern ditch in loamy soil.

By the table we find that the large ditch (4.5-ft. top) will carry 8.28 second ft. of water when given a fall of 1 in. per 100 ft., and the velocity 1.47 ft. per second is not excessive for this material. In the last column it is seen that the ditch would require 1,100 cubic yards of excavation per mile if made entirely in the ground. This is seldom done, as it increases the difficulty of turning water out of the ditch, and the grade and ground lines seldom agree sufficiently to avoid cuts and fills entirely.

I Should Worry!

Tacks don't bother ***me.*** That's what the fellow above means to say. And you can say it too. There are no sharp-pointed stones or tacks to worry about. Half the time you won't even know that you've had a puncture if your tires have been treated with

NEVERLEAK Tire Fluid

NEVERLEAK heals up the punctures just as fast as they occur and you can keep right on your way. No stopping to pump up. It heals them ***on the run.*** You lose a lot of fun by having to lay up your bike for puncture repairs every now and then. Why not let NEVERLEAK keep your tires in trim? Buy some today and put a tube in each of them. 25c at all dealers and repair shops. Get the yellow and green tube, the original NEVERLEAK.

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Get This Car

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Drive a new 1919 Birch SUPER-FOUR and make good money selling Birch cars to your friends and neighbors. They are fully guaranteed. Prompt shipments. Write quick for full information.

36 h.p., 115 inch W.B., 32x3½ tires

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Raise Belgian Hares

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A practical treatise on electrical calculations of all kinds reduced to a series of rules. $1.00 *Postpaid.*

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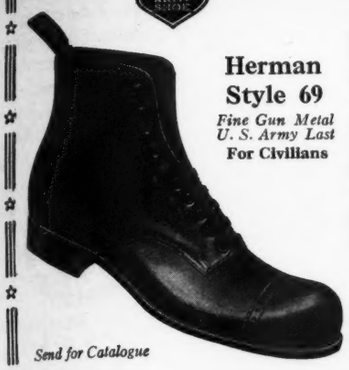

Herman Style 69

Fine Gun Metal
U. S. Army Last
For Civilians

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WHAT a wealth of practicable knowledge about the *comfort* and *wear* of shoes built on the Munson U. S. Army Last the returning American soldiers are bringing to the men at home!

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$388 BUYS THIS "PRESTO-UP" Bolt-Together House

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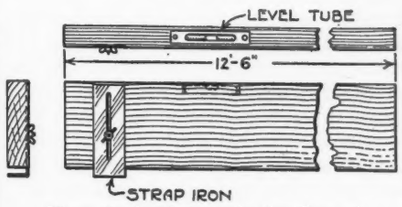
Houses—Garages—Barns—Out Buildings, etc. Also Harris Fresh Air Canvas Houses

HARRIS BROTHERS CO., Chicago

The ditch is now located by setting a peg at the intake and leveling from this with the foot set ⅛ in. from the 1-in. fall per 100 ft. Lathe pegs are driven 12 in. 6 ft. apart, measuring



Upon the level depends the flow of water, and great care should be taken to get all measurements exact

with the board, one end on the upper peg and the iron strap of the other being set. When the board is level the tops of the pegs are on the 1-in. grade. This method is continued to the end of the proposed ditch, and the last peg will be as high above the bottom as the first. The level should be tested by reversing ends on a pair of level pegs.

By making the ditch on an offset from the staked line, the grade pegs may be preserved for checking the finished work. To open the ditch, plow a couple of deep furrows along the line and throw out the earth with a V scraper. Then cut the bottom with a ditching-plow made by fitting both a left and right share and mold-board into a stout plow-frame. The banks are pushed out with the V and settled by dragging. The ditch may then be given a final shaping with shovels. This is much faster and neater than slip-scraper work for small ditches.

Where it is desired to reduce the grade in a ditch, some means must be provided for removal of the sand that always deposits where the flow is checked and the ditch enlarged because of the reduced velocity of the stream.

Earth ditches are very wasteful of water, and should be lined with cement or replaced with concrete pipe wherever the value of the water will justify the expense.—E. EARL GLASS.

Baltimore Discovered to be a Genius City

THE world's first telegram was received in Baltimore May 24, 1844, at old Mount Clair Station. Its contents were: "From Washington to Baltimore. What hath God wrought!" Baltimore had the first public building to be lighted by gas. It owned the first gas company founded in America, June 17, 1816. America's first railroad ran from Baltimore to Ellicott Mills (1830). The old Baltimore shot-tower was built in 1828; it was 240 ft. high. Baltimore raised the first monument to George Washington. It built the first clipper-ships. The first merchant submarine to cross the Atlantic, the *Deutschland*, docked in Baltimore. It is the birthplace of the "Star-Spangled Banner." The first successful submarine was invented and used in Baltimore by Mr. Simon Lake.—JOHN WEAVER.

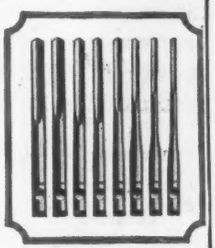
Tension Adjustment

SEVEN TENSIONS

in this clever Automatic Drill "make better mechanics" and help the best mechanics produce more and better work.

For instance—the adjustable tension of the "YANKEE" No. 44 Automatic Drill really amounts to an adjustable feed. You increase the tension for large drills in hard material; enables more pressure on the drill point.

Decrease tension for fine drills or fragile material; the drill point revolves with less pressure. Less danger of breaking the drill point or harming the work.



Eight Sizes *of* Drills

Eight "YANKEE" Drill Points, 1-16" to 11-64" in handle. Arranged with the open end *up*—toward chuck. All are exposed together for convenient selection.

"YANKEE"
No. 44 Automatic Drill
Price $2.45

Your Dealer Can Supply You

"YANKEE" Tool Book sent free. Shows "YANKEE" Tools in action and better ways of drilling, boring, tapping and driving and drawing screws.

North Bros. Mfg. Co.
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"YANKEE" TOOLS
Make Better Mechanics

Columbia BICYCLES

THE lowest-cost and most dependable means of transportation to and from work. Independence of excessive trolley and suburban fares. Rides before and after business that promote health, happiness, and strength.

Just the model you want at just the price you're willing to pay—for boys, girls, men, women—with all the features of strength, endurance, design, snappiness, and ease that have made and kept the Columbia the Standard of the World.

Remember, the Columbia Military Model was chosen as standard for the U. S. Army following thorough tests by Government engineers of all American-made bicycles.

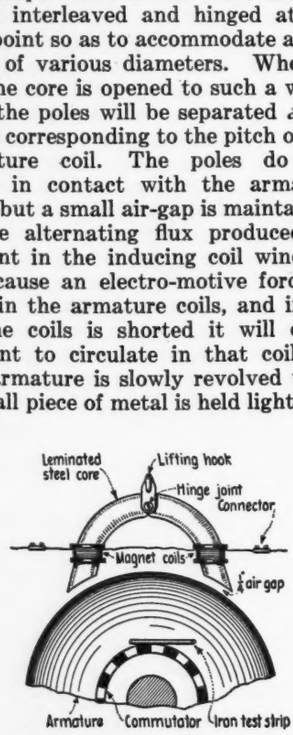
All models described in 1919 Catalog. Sent anywhere.

WESTFIELD MFG. CO.
45 Lozier Ave., Westfield, Mass.

This Inducing Coil Locates Armature Troubles

AN alternating-current inducing coil is sometimes employed for locating armature troubles. The inducer consists essentially of a magnet having a U-shaped core of thin steel laminations, interleaved and hinged at the mid-point so as to accommodate armatures of various diameters. When in use the core is opened to such a width that the poles will be separated a distance corresponding to the pitch of one armature coil. The poles do not come in contact with the armature core, but a small air-gap is maintained.

The alternating flux produced by current in the inducing coil windings will cause an electro-motive force to flow in the armature coils, and if one of the coils is shorted it will cause current to circulate in that coil. If the armature is slowly revolved while a small piece of metal is held lightly on



This clever little trouble-finder produces an arc when the coil is working properly

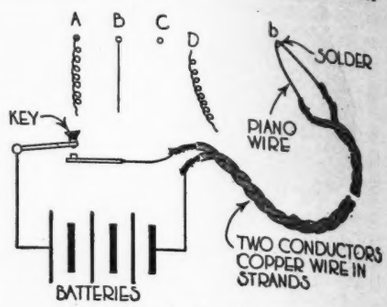
the commutator, an arc will be produced each time two of the segments are bridged, provided the segments are connected to a normal coil. If the coil, however, is open, shorted, or reversed, there will be no spark.

To determine whether the trouble is due to a short- or open-circuited coil, the small iron test strip is bridged across the armature slots. With a shorted coil the induced current will create around the coil a flux which can be detached when the test strip is moved over the armature slots. In addition, a shorted coil will be quickly heated up by the local current flowing in it.—PETER J. M. CLUTE.

A Difficult Job in Electrical Soldering

THE following method of soldering in a tight corner and on small wires may be of interest. The proposition was to solder the wire *D*, which was the finest silver wire obtainable, to the point *C*, where *A* is a similar soldered joint and *B* is the point of attachment, also soldered, of the galvanometer suspension of which the wires to *A* and *C* are the current-bearing connection. The points *A*, *B*, and *C* are about ¼ in. apart, and the fine wires burn off with the least overheating.

The job was performed with the following simple equipment. A good, heavy, two-strand wire cable was used to connect up, in series, a telegraph-key *K* and three dry-cells. The cells and key lay on the floor, and the cable



Here's a valuable idea that all electricians should know about

was made long enough to reach from the floor up to the height of the job. At the upper end of the cable a piece of piano wire, 2 in. long and about No. 20, was inserted, by twisting the copper wire after being bent to form a blunt point at *b*. The terminal *C* was scraped, and then, by closing the key with the foot, the iron wire became red-hot, and was used to clean and tin the terminal.

The iron wire was then cleaned in an alcohol lamp and tinned, and a small drop of solder allowed to remain inside the curve at *b*. The point of the hanging wire *D* was difficult to see, being very fine; but the iron wire loop was at last able to locate it, and the point *D* rested on the cold solder. The key was pressed with the foot, the solder softened, the key was released, and the solder cooled with the wire *D* firmly soldered to the iron wire.

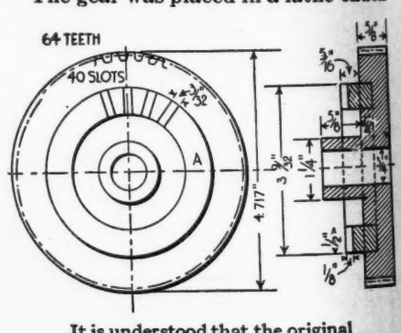
The iron wire was carefully raised till the wire *D* was pressed firmly on the terminal *C*.

The act of again pressing the key gave the necessary local heat to complete the job.—ERNEST A. HODGSON.

Repairing a Feed-Index Gear for a Planer

SEVERAL broken teeth on the feed-index of a planer were repaired in the following manner.

The gear was placed in a lathe-chuck



It is understood that the original gear was made in one piece

and centered very accurately. The indexing gear *A* was turned off, and a recess bored out to take a new ring the

size of the old broken ring. (See the drawing.)

A ring was turned and bored to fit the recess (allowing a force fit), and forced into the recess. Two small holes were drilled through the gear to permit the escape of air.

The cutting of the slots in the ring had to be done on a shaper, and this was accomplished by the use of a simple index jig design to index four and six parts, set up as shown in the photograph.

The number of slots being forty, a gear having forty teeth was placed under the indexing gear on the revolving disk of the jig, and the whole was held in place by a bolt, as shown. A finger was fitted between the teeth of the forty gear, and by this arrangement a movement of one tooth at a time could be made and thus give the proper spacing on the ring being cut.—HARRY MEAD.

Finding the Worn Spots on a Printing-Press

AFTER a few years of use a large cam on a printing-press became worn all around, but in some places more than others, as shown at *A*, Fig. 1. In one case, the roller running

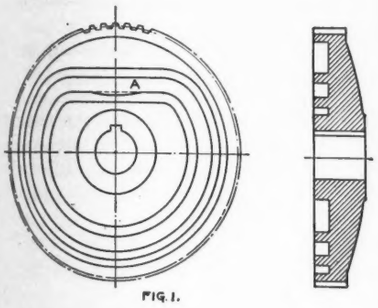


FIG. 1.

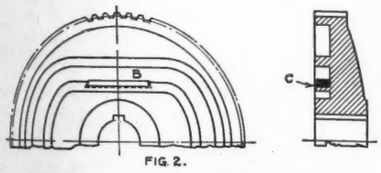


FIG. 2.

This job was done in six hours with hammer, chisel, file, and a small power lathe

in the slots was used to locate the worn places. This was done by running the roller in the slot and using slips of paper between the roller surface and the metal of the slot. The amount of wear was determined by the number of sheets of paper necessary to fill the space.

A new roller was turned to fit the average depth of wear, and all high places were filed down so that the roller would pass through snugly. The place most worn was filled with a piece of steel, as shown at *B*, Fig. 2, the piece being just a trifle narrower than the depth of the slot. The edge at *C* was peened over to hold the piece in place.—WILLIAM PHILIP.

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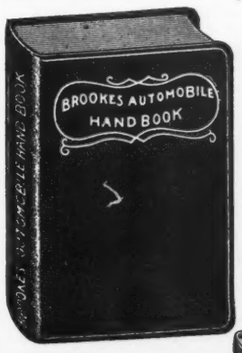

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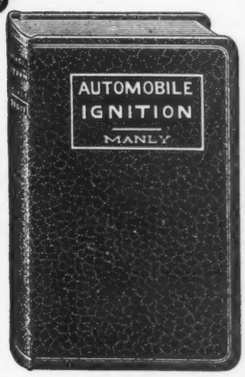

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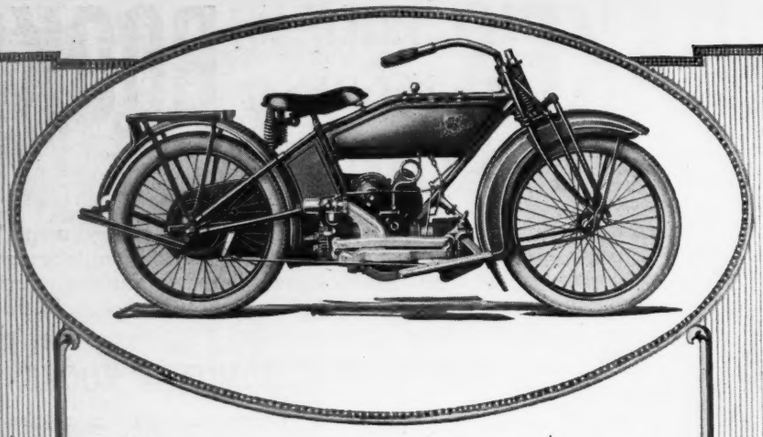

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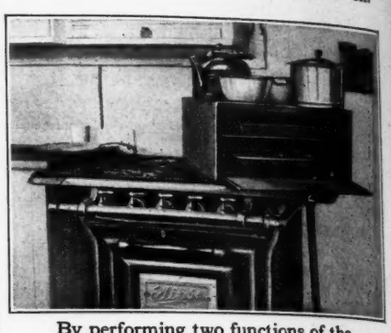
This Remarkable Oven Bakes and Boils

AN oven that bakes and boils at the same time is the invention of a Californian. The oven stands on top of a gas- or oil-stove, and requires only one ordinary-sized burner to bake and cook perfectly everything that can be placed into or upon the oven.



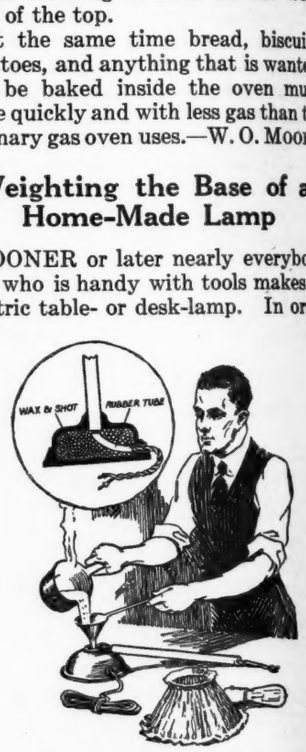
By performing two functions of the cook' stove this oven saves fuel

Holes are provided at the back on top, in which kettles are placed when it is necessary for quick cooking, while slower cooking is done on the front part of the top.

At the same time bread, biscuits, potatoes, and anything that is wanted, can be baked inside the oven much more quickly and with less gas than the ordinary gas oven uses.—W. O. MOORE.

Weighting the Base of a Home-Made Lamp

SOONER or later nearly everybody who is handy with tools makes an electric table- or desk-lamp. In order



An efficient means of making that lamp steady on its base

to have a really satisfactory lamp the base must have proper weight.

Melt some candle-wax in an old tin can, stir in several ounces of common lead shot, and while the wax is soft pour the mixture into the lamp-base. The wax keeps the shot from moving.

Before pouring the wax and shot into the base, it is better to slip a piece of rubber tube over the wire as shown in the drawing.

This prevents the wax from binding the wire, and in case of necessity the wire can be taken out or put in without removing the wax.—ALBERT E. JONES.

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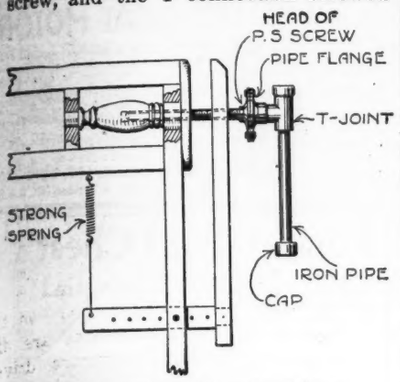
How to Make a Bench-Vise from a Piano-Stool

A WOODEN bench-vise may be cheaply constructed by using an old piano-stool or revolving desk-chair for the screw.

The legs, etc., are knocked off, and the center part is set into the bench. The top is unscrewed, and a wooden or pipe handle is inserted. A steam-pipe or floor flange is bolted to the top of the screw, and the T-connection screwed



With a little skill and patience the old piano-stool can be transformed into a practical bench-vise

into the flange. Then a 1-ft. length of a smaller-sized pipe is slipped through the T-joint, and pipe-caps screwed upon both ends, making a strong sliding handle.

The bottom is made adjustable for different thicknesses of wood by a wooden guide with holes for inserting a nail at intervals, and a strong spring keeps the vise always open.

The illustration shows a cross-section of the bench with the piano-stool vise.—V. H. TODD.

A Practical Piston Vise that Is Cheaply Made

AN inexpensive and very serviceable piston vise can be made from an ordinary pipe-cap, which may be bought at any steam-fitters' or hardware store. For a Ford engine piston a 3½-in. pipe-cap is about right. The hexagon type is better than the round, as it can be clamped in the vise firmly and much more easily.

Try this vise on your pistons

Insert the pipe-cap into the lathe, and cut out the end so that the piston will slip through; then cut notches into it so that a rod which will go through the piston-pin will fit into the notches. If the hole through the cap is made large enough it can be lined with leather, so there will never be any danger of damaging the piston or piston-rings.

This vise is just as serviceable as the piston vises on the market retailing for $10 or more, and by its use there is no excuse for bent and twisted connecting rods.—OTIS H. TODD.

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Here's a New Use for the Cotter-Pin

EVERY so often a rod, rivet, or key must be inserted into an almost inaccessible place in the automobile engine or chassis, and it is difficult to find a pair of pliers small enough for the purpose.

A small washer is slipped over a large cotter-pin, and the rivet or key inserted in its end, the washer being

A time- and temper-saver is this little suggestion for motorists

wedged forward to hold it sufficiently to enable the part being slipped back into place.

This suggestion is invaluable in replacing keys under the valve-springs in an engine.—G. F. COLLINS.

Revealing the Secret of a Perplexing Card Trick

PROCURE a set of numbered cards or calendar dates, and arrange them in order from one to ten. Also have one card with a cipher on it. Place the "cipher card" face downward on the table, and then put "one" on top of it, "two" next, and so on up to "ten."

Allow somebody to cut the numbers, but make it plain that the cards mustn't be shuffled.

While you are blindfolded or out of the room, one of the spectators is allowed to remove as many cards as he chooses from the bottom of the pack, one at a time, and place them on the top of the pack. When he has finished you return to the room, and, without asking a question, turn up a card with the figure "three" on it. "Three" proves to be the actual number of cards removed.

This you can repeat indefinitely. It is extremely simple, requiring no practice whatsoever. Arrange the cards in the beginning in this order: 0-1-2-3-4-5-6-7-8-9-10. No matter how many times they are cut, you remember what the bottom card is before you leave the room.

For illustration, supposing the cards had been cut seven or eight times, leaving a "five" on the bottom. Now, no matter how many cards, one at a time, are removed from the bottom to the top in your absence, the fifth card when turned over will be right.

Get a look at the bottom card, which in this case will now be a "seven." Again let somebody remove cards. Turn up the seventh card from the top, and it will be the exact number moved.

This trick cannot fail. Try it with pencil and paper as you read along, and you will be convinced that it is clever.—CLARENCE T. HUBBARD.

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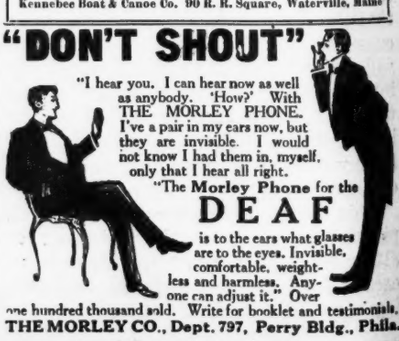

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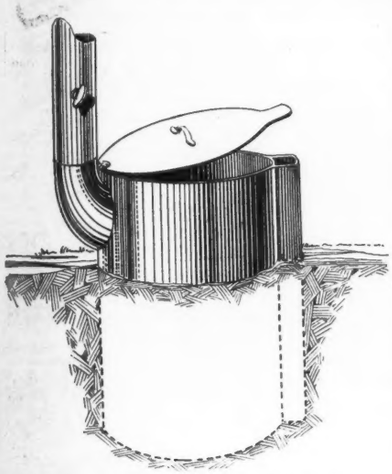
Save the Chicks with a Twofold Tank Heater

A BIT of farm management that has resulted in saving many thousands of young chicks was devised and used by the Matt Schock family, of Linn county, Missouri. This useful stratagem consists of a twofold use for the farm tank heater: for its original purpose in winter, and as a heater for the brooder-house in spring.

An ordinary cast-iron tank heater is sunk into the earth floor of a rat-tight and rain-proof brooder-house. It is sunk so deeply into the ground that the heat is conducted upward and outward through the soil, rendering the floor of the brooder-house comfortably warm and dry.

"The chicks spend the coldest nights of May and June around this little heater without the need of bedding or cover of any kind," says Mr. Schock. "They lie sprawled out on the ground in positions of evident comfort, and the wide circle that they form about the heater narrows or widens, as the temperature goes up or down. We do not need a thermometer in this brooder-house; we simply look in at night just before we go to bed, and if the circle of chicks has tightened up close to the heater we drop in another chunk of wood; if the circle has widened out three feet or so from the source of heat, we know the place will keep warm until morning."

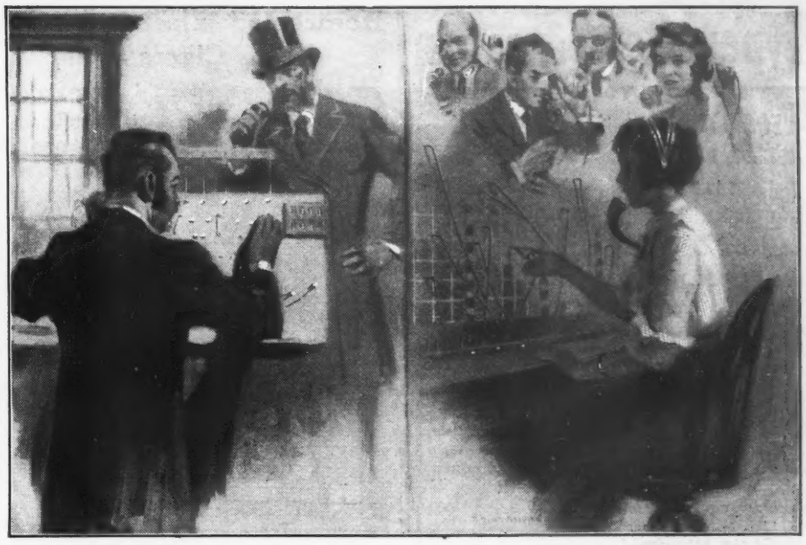


Give your chicks a stove in winter; they will reciprocate by growing fat

This plan has been used successfully for four years. The brooder-house is 8 by 12 ft., with a good shingle roof and a rat-proof foundation of concrete. There is no bedding even for the day-old chicks.

Since this plan was first originated, no chicks have been lost from bowel trouble, for the warm earth seems to keep them in perfect condition.

The earth floor is scraped clean every day, and occasionally clean new earth from field or garden is added. This is heated until it is thoroughly dry before the chicks are permitted to sleep upon it. The house accommodates one hundred and fifty chicks.—A. A JEFFREY.



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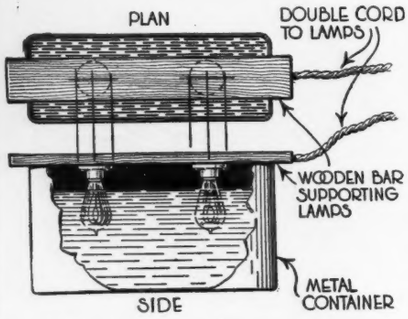
CIGAR-STORE dealers will find the humidifier herewith described to be particularly efficient and demanding but little attention. Its construction



The ever necessary cigar humidifier can now be made by anyone

may be varied to suit the taste of the builder.

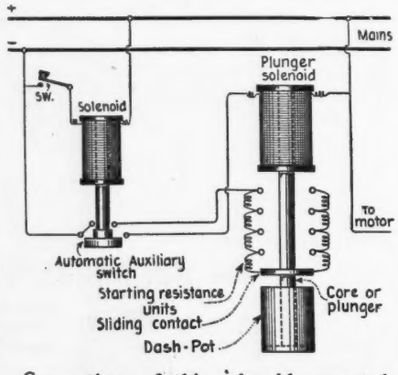
Procure a square tin can of considerable depth. A tinsmith will make this for you at small cost if there is no can available. Copper plating will add to its appearance, although this is not necessary. Cut a wooden bar from a piece of stock, sandpaper and varnish it, and attach lamp-sockets thereto and connect in parallel by double-insulated copper wiring. Connecting this apparatus to the show-case will, of course, depend upon its construction, but long brass screws will give the best service.

Fill the container with sufficient water to immerse the lamps, and the apparatus will be ready for use.

The lamps are turned on at intervals, heating the water sufficiently to keep the cigars as moist as is necessary.—HERMAN NEUHAUS.

A New Automatic Starter for the Motor

SOME types of starters for motors employ the solenoid arrangement, illustrated diagrammatically in the accompanying illustration, while others



Connections of this solenoid-operated motor starter all lead to a master switch

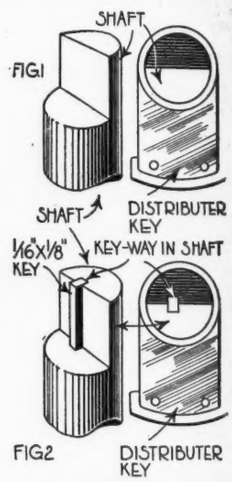
consist of a series of contractors or automatically operated switches, which are arranged in sequence to cut out the starting resistance as the motor increases in speed.

Where a solenoid-operated starter similar to that illustrated is employed, a master push-button or switch is used to complete the control circuit through an auxiliary switch. When the automatic auxiliary switch is thus closed the circuit will be completed through the plunger solenoid. This being the case, the solenoid is energized, pulling the core or plunger up into it, thus cutting out of the motor circuit, as the plunger rises, the graduated resistance units of the starting rheostat.

Attached to the plunger is a piston, movable in a dash-pot, as shown. Thus the core is prevented from rising suddenly and cutting out the starting resistance with too much rapidity.—PETER J. M. CLUTE.

Another Way of Foiling the Automobile Thief

THERE are many ways and means used to prevent the automobile thief from registering satisfaction, but



The "port of missing cars" will be minus a few automobiles if this idea is adopted

the simplest and most practical I have ever seen is the following.

In the same garage where I stored my car there were a number of other cars of the same make and model. I discovered that if for any reason the other cars were out of order some of their owners would at times use my machine without my knowledge or permission.

At first I tried to prevent this by removing the distributor switch or key, but they soon learned to substitute their own.

One day I thought out a remedy that worked to perfection. I took out the distributor-shaft, and milled a small keyway in the flat in the manner shown in the sketch, the keyway slightly out of center. Into the keyway I fitted a small key about 1/16 in. wide and high. I then drilled and filed a corresponding keyway in the distributor-key. Now the other fellows cannot use their keys on my machine, because they do not fit.—JOE V. ROMIG.

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Two Ways of Starting Induction Motors

THERE are two methods of starting induction motors in general use. For smaller motors, above 5 h.p., the method shown diagrammatically in Fig. 1 is more often used.

The amount of reactance in each line can easily be adjusted by connecting points on the auto-transformer. The

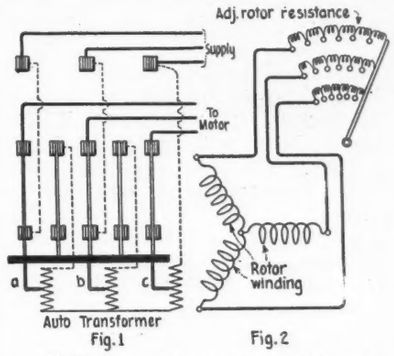


Fig. 1 Fig. 2

This diagram shows the simplicity in the arrangement of the wiring

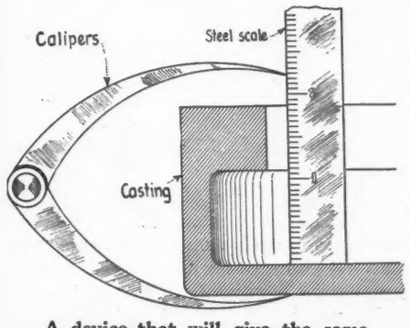
greater the value of the reactance placed in the circuit, the slower will be the starting speed of the motor. When the motor gets up to speed, the switch is thrown up, allowing full-line voltage directly on the motor.

Another method, commonly used for the larger types of induction motors, is illustrated in Fig. 2. This method consists of inserting resistances in the rotor circuit, so proportioned that the starting power of the motor will be just as great with it in circuit as without it. This is useful where heavy starting power is desirable.

Transferring Dimensions by a Useful Method

OWING to the peculiar form of some castings or other articles that are to be measured, it is sometimes found impossible to transfer a dimension with ordinary calipers. In such cases the dimension may be obtained by moving one of the caliper legs to one of the inch marks on a steel scale or rule, as shown in the accompanying sketch.

The calipers can then be withdrawn and applied to the scale. This number of inches originally taken is then deducted from the total amount, thus giving the required dimension.



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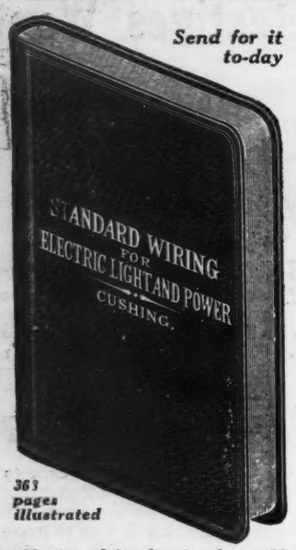

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Its Oddity Does Not Make It Impracticable

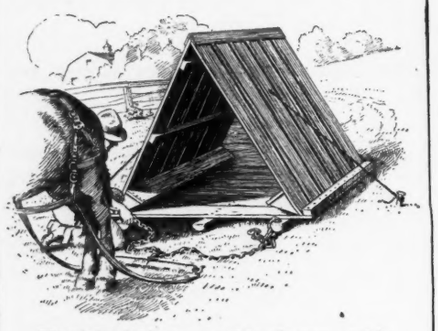
A PORTABLE hog-house, fashioned like a tent for summer camping, and transported from place to place by means of a chain and single-tree, is the latest oddity in hog-house construction. Its quaintness, however, does not argue against its practicability. The farmer may construct this A-shaped home for piggy in his own back yard with the proper specifications and material.

It should be built of 1-by-12-in. plank. The opening should face south. The floor is 8 ft. wide and 6 ft. from front to back, nailed to three runners or skids. The skids may be built of lumber or poles 6 in. in diameter and flattened on one side, to which the floor is nailed. A hole bored through the front end of the outer skids will give access to the chain and single-tree, to which a horse or team is hitched.

A piece of 2-by-4-in. material supports the outer edges of the top of the floor to prevent the house from spreading at the bottom.

The sides of the house are built of six pieces of 1-by-12-in. plank 8 ft. long, nailed to a piece of 2-by-4 lying flat 9 in. from the top of the plank, another 3½ ft. from the top, and a piece of 2-by-8 nailed edgewise 11 in. from the bottom. A right-angle block of 2-by-8-in. will serve as braces at each end of the under side of the house.

The long piece of 2-by-8 will serve as a "safety first" measure for piggies whose careless mother would just as



Hitch Dobbin on to this pig-pen and it can be conveniently hauled anywhere

soon flop down on her brood as in a puddle of mud.

The materials required are 13 pieces of 1-by-12-in. by 16 ft. for the sides, back and floor of house; 9 pieces of 16-ft. batten; 3 pieces 2 by 4 in. by 12 ft. for the framework; 2 pieces 2 by 8 in. by 12 ft. for the rail or guard; 1 piece 1 by 6 in. by 16 ft. for the saddle-boards; 3 poles for skids; nails. The cost will probably be about twelve dollars.

The advantages of a portable hog house are apparent. The house can easily be moved from spot to spot, permitting the ground underneath to keep in a fertile condition. The pigs enjoy being moved about and reciprocate by taking on flesh.—S. R. WINTERS.

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LIKE many other things, an oilstone can be ruined by wrong treatment and lack of care.

There are three objects to be attained in taking good care of an oilstone: First, to retain the original life and sharpness of its grit; second, to keep its surface flat and even; third, to prevent it from glazing.

To retain the original freshness of the stone, it should be kept clean and moist. If an oilstone remains dry

Oilstones are a necessity for the mechanic and their proper care leads to efficiency and economy

or exposed to the air for any length of time it will harden. A new natural stone should be soaked in oil for several days before using. If an oilstone is kept in a dry place, it should be placed in a box with a closed cover, with a few drops of fresh, clean oil left on it.

To keep the surface of an oilstone flat and even simply requires care in using. Tools should be sharpened on the edge of the stone as well as on the middle to prevent wearing down unevenly, and occasionally the stone should be turned end for end. To restore a flat, even surface, grind the oilstone on the side of a grindstone or rub it down with sandstone or an emery brick.

To prevent an oilstone from glazing requires merely the proper use of oil or water, either of which floats the particles of steel that are cut away from the tool, thus preventing them from filling in between the crystals and causing the stone to glaze.

Oil should be used on medium- and fine-grained natural stones and artificial stones. The dirty oil should be wiped off the stone as soon as possible after using it. This is very important, for if left on the stone the oil dries in, carrying the steel dust with it. Cotton waste is one of the best things to clean a stone with.

Should the stone become glazed or gummed up, a good cleaning with gasoline or ammonia will usually restore its cutting qualities; but, if it does not, scour the stone with loose emery or sandpaper fastened to a perfectly flat board. Never use turpentine on an oilstone.—F. H. SWEET.

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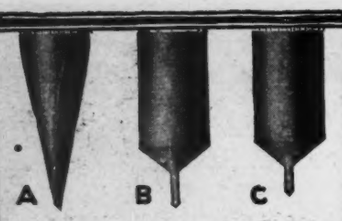

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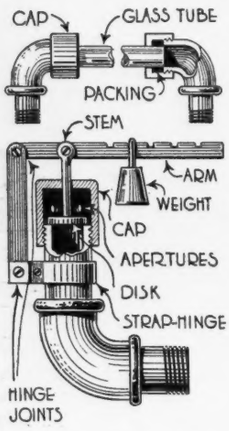
Big Power in the Old Kitchen Boiler

By H. W. Hahn

ALTHOUGH numerous articles have appeared at various times describing the construction of all kinds of small steam-engines, the description of a good boiler for practical engines has been neglected.

An old discarded kitchen boiler or hot-water tank can be used advantageously for this purpose, and should be about a foot in diameter and five feet long. By using a long fire-box it takes only a half hour to get up steam, and a boiler of this size will provide a plentiful supply of water and steam, enough for a half day's run, with only one filling of water.



The safety-valve prevents the boiler from exploding; it is easily made

Make the fire-box of galvanized or black sheet-iron, about ½ ft. shorter than the boiler length and about 2 in. narrower than the diameter. Provide a door at one end, as well as a clean-out door below this and a hole for a stove-pipe at the other end. The wires are to be drawn up after the boiler is placed in the cradled shape, to keep the sides tight against the boiler, as they tend to bulge when the fire is hot.

The boilers usually have two holes in the top, two in the bottom, and one in the side. These should all have plugs screwed into them, and then they can be tapped out for smaller fittings. If there are any other holes in the boiler, these should also be tapped out very carefully, because the metal is not very thick.

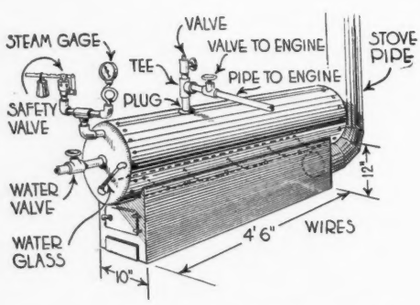
A good arrangement of fittings is shown in the lower illustration. The steam-gage can be a second-hand one; it can even be omitted and the pressure determined approximately by the safety-valve. When admitting water through the valve in front, always remove the weight on the safety-valve, and also open the valve near the engine-valve. Never add water while there is pressure up, and never let the water-level get low. In case it should ever get too low, draw the fire and open all the valves. We have had the steam-gage register its limit, fifty pounds, but the best pressure is around twenty-five, because the water-glass fittings will leak pretty badly at forty or fifty pounds.

The safety-valve can be made from a short pipe screwed into an elbow. Dress off with a fine file one end, but leave a few threads so a cap can be screwed on. This forms the valve seat, and should be perfectly smooth. Cut out a disk of a diameter that will easily slide into the cap, screw a stem into the disk, and flatten the end for a small bolt. Three or four holes are drilled in the sides of the cap to allow for escaping steam when the valve lifts, and one hole is drilled in the center of the cap to let the valve-stem fit loosely. Strap-iron is used for the arm, clamp, and link.

The notches for the weight can be placed as desired, depending on the weight used. The area of the exact inside diameter of the pipe must be calculated from the formula, the area equaling the diameter squared, divided by 4 and multiplied by 3.14.

For example, say the diameter is exactly ½ in., then we have ½ times ½, which is ¼, and ¼ divided by 4 equals 1/16. Then 1/16 times 3.14 is a little less than .20 sq. in. Now suppose the pressure on the disk is 5 lbs. per square in., then, as the disk is but 115 sq. in., the steam pushes up on the arm with a force of one pound. We will say that the arm-hinge hole and the hole for the stem-bolt hole are 1 in. apart, so to balance a ½-lb., weight the weight will have to be 2 in. from the arm-hinge.

In a similar way, if the weight is 6 in. from the hinge, then we have 6 times ½, or 3; dividing by 1 is 3, and multiplying by 5 is 15 pounds pressure in the boiler. With a 1-lb. weight 6 inches out, the pressure would be 30 pounds. The pressure can be found within 1 lb. by making the notches at certain distances from the hinge and finding the point where the valve just blows off.



This boiler will do as efficient work as any of the high-priced manufactured kind

The water-glass can be made as shown in the sketch. The caps have holes drilled in them to let the tube slip through loosely, and the elbows should be large enough to let the tube slip loosely into it, too. Some string or packing is then wrapped around the tube, the cap is screwed on carefully, and your home-made steam-engine is complete.

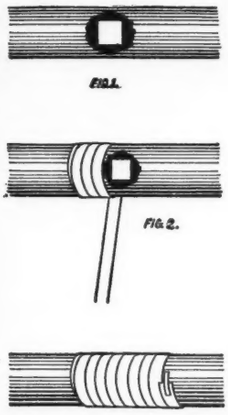
First Aid to the Leaky Water-Pipe

THERE are two neat and practical ways of temporarily stopping a leak without the use of solder. The first and most durable is as follows:

Shut off the water in the cellar, and open the faucets, letting the water in the pipe run off; then wipe the pipe thoroughly dry all around the hole. If there be any rough edges, tap them smooth with a hammer; then cut a patch out of thin, tough paper about ½ in. larger all around than the hole.

Next, coat one side of the paper, and also the pipe, with shellac, and while they are both still wet put the patch on, being sure that it lies smooth and that all possible chance of the water leaking out is prevented by the shellac. Apply a thin coat of shellac on top of the paper and around it on the pipe, as in Fig. 1. Then let it dry. It will not take long, as shellac sets very quickly.

After the shellac is dry, take a piece of old cotton cloth and tear it



A leak in a water-pipe, whether caused by wear or freezing, is very annoying, but you can remedy it yourself

into a long, narrow bandage about 1 in. wide, and begin wrapping the pipe, about 1½ in. to the left of the patch (Fig. 2). Before covering the patch give it another coat of shellac. Let the shellac extend beyond the patch on all sides; then, while the shellac is still wet, continue bandaging over it. Fasten the end of the bandage with shellac or adhesive tape. The tape may also be used for the bandage if you prefer. When the last coat of shellac is dry, you may turn on the water without fear, for you have a repair that will be absolutely watertight and that will last for some time.

Another method (Fig. 3), not so durable, but useful in an emergency if no shellac is at hand, is to use ordinary melted candle wax in place of the shellac. Only, in this case, when the patch is put on the pipe must be warmed to keep the wax from setting too quickly; then bandage as described.—ALBERT E. JONES.

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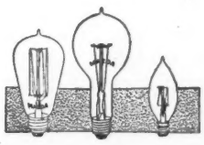

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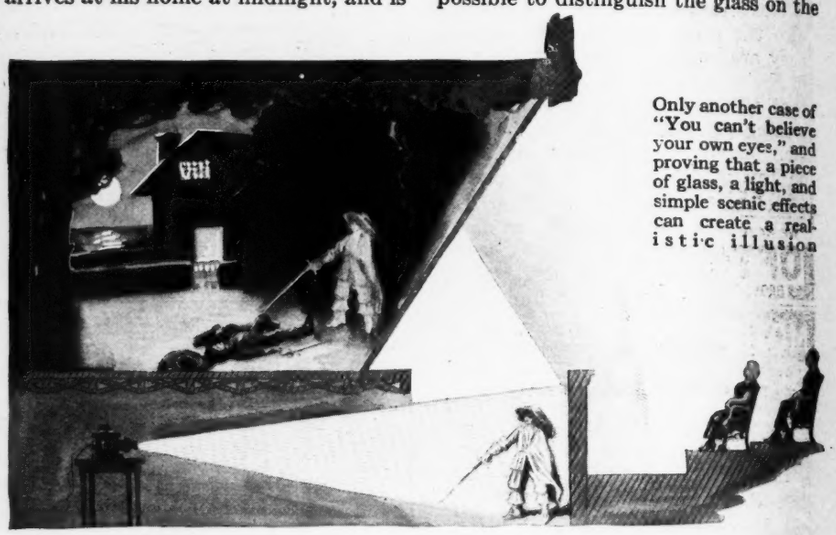
A Ghost that Fought a Duel

By Harry Marcelle

ONCE I had the pleasure of witnessing a rather unique stage illusion in which a ghost was made to appear and fight a duel.

The plot deals with two men who are twins. In a quarrel one of them is killed by his brother, who disposes of the body in the dead of night. This is shown in the first act. The war begins, and the living brother is sent to the front. Several months pass, and the soldier returns from the trenches. He arrives at his home at midnight, and is about to enter the house, when the ghost of his dead brother appears in the doorway. He calls, but receives no reply. Swords are drawn, a duel is fought, and the ghost kills his adversary and vanishes.

During the entire action of the duel the sword of the living brother passes through the figure of the ghost with absolutely no effect. The ghost appears to be only a thin vapor, while the body of the living brother is clearly seen through the ghost's body.



Only another case of "You can't believe your own eyes," and proving that a piece of glass, a light, and simple scenic effects can create a realistic illusion

How It Is Done

The duel is brought on the stage in a rather dim blue light so as to carry out the effect of its being late at night.

Part of the stage or trap at the curtain line is removed, this not being perceptible to the audience. Beneath the stage is placed a stereopticon machine, as shown in the illustration. The wall in back of the figure is draped in black cloth. The character beneath the stage dresses in white, duplicating the costume worn in the first part of the play by the dead brother. A sheet of plate-glass is placed at an angle leading from the opening in the stage to the borders overhead, continuing to the center of the stage where the action takes place.

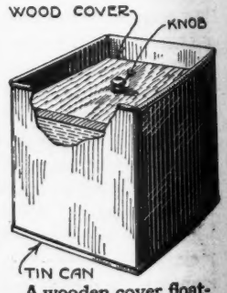
At rehearsal the spaces on the stage are marked. The space beneath the stage is also marked to correspond with that on the stage. All the cues are taken from the music played during the duel. When his cue is given the brother in white steps beneath the open stage. The light is then thrown on him from the stereopticon, his image appearing reflected in the glass. Every movement that is made by the performer beneath the stage is followed by the performer on the stage. This is, of course, rehearsed thoroughly beforehand, otherwise there would be no realism to the duel. When the lights in the house are extinguished it is impossible to distinguish the glass on the stage. With a little study of the illustration the idea may be constructed in miniature and many interesting experiments can be derived by the use of manikins or dolls.

Keeping Paint Fresh by a Simple Method

WHEN paint is left uncovered a portion of it congeals at the top of the can, and must be thrown away. This waste can be entirely eliminated, as follows.

Using an ordinary square oil-can about 9 by 9 in. for the paint, cut a piece of board about ⅜ or ½ in. thick, to slide down into the can and float upon the surface of the paint. A knob or wood screw in the top will suffice to lift it off. The small amount of surface paint left around the edge is negligible.

In storing surplus paint for future use, fill the can right up to the top with paint, press the lid down on the paint, and brush a little paint around the edges of the lid. It will soon dry and the paint underneath will keep indefinitely.—FRED D. HOOD.



A wooden cover floating on the paint keeps it from spilling over

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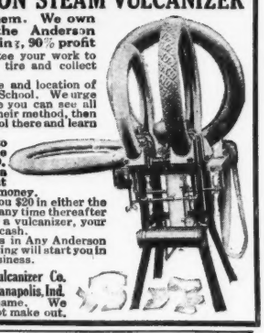

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Make a Pocket-Knife from Old Razor Blades

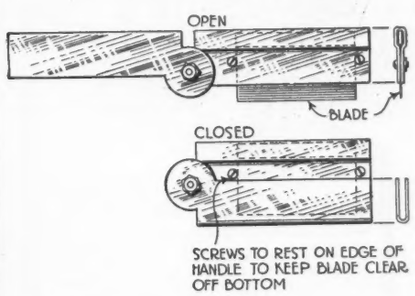
YOU throw away your old safety-razor blades, don't you? But you won't when you know that you can make a pocket-knife that will utilize these old blades.

The illustration shows the knife opened, with the blade at one end held between two screws, and also closed, making it safe and convenient to carry about in the pocket.

The holder of this pocket-knife can be made of any durable metal, such as copper or brass, that is easily hammered. The blade is pushed into the slot of the knife-holding part, and the screws are fastened at each end. The blade is then held rigid by pulling the screw tight.

The cover or handle piece is formed into a U-shape and attached to a screwed pivot. On closing the handle, the edge will rest upon the two screws and prevent it from falling upon the blade to dull its edge.

Do not make the cutting edge more than 3/16 in., or it will be too flexible and break easily. The metal could be of 3/32 in. stamping, and the screws about 3/32 in. in diameter by ¼ in. long. The blade-holding part is made from a piece of metal 2 in. wide by 2½ in. long on each piece for the circular hinged part.



Here's a use for your old razor blades; for a clean-cut edge this knife is excellent

To determine the exact length of the knife-blade, lay it on the metal and allow ¼ in. for the screw and clearance. On the other end ¼ in. for the screw and 1 in. for the other swinging flap.

This device enables many old safety-razor blades to be put into good use, where they were formerly thrown away.—AARON D. PRONER.

More Ideas on How to Utilize an Inner Tube

WHEN I find that an inner tube has become unserviceable, I cut the rubber tube into strips and use them for rubber bands, which I find are extremely good for heavy packages—for instance, boxes and packages that need to be held together substantially.

I have also used an old tube for radiator connections when caught in a pinch.—RODNEY G. BRYSON.

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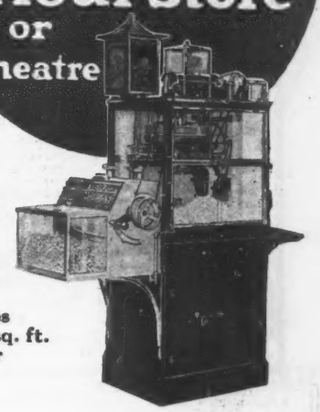

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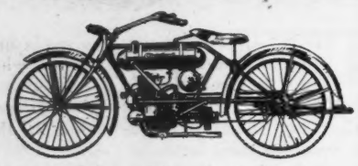

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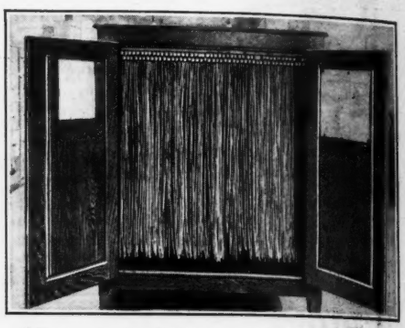
A Plan for Filing Tracings in Engineering Offices

IN all engineering offices records are considered one of the biggest assets. Maps, and the tracings made from them, constitute some of their most important tools. As is seldom the case with valuable possessions, it is almost harder to keep these records in good condition than it is to acquire them. But, like the mountains in "Pilgrim's Progress," there is always a way over for those of stout will.

Some offices have adopted standard methods of filing all other papers than tracings, maps, etc.; but in the filing of these there seem to be numerous systems.



No reason to clutter up your office with blue-prints if you adopt this method

Frank A. May, of Buffalo, sized up the situation in a nutshell when he said: "By constant innovations and changes in systems, the workings of an office may be kept up to scratch and abreast of the times. This is the policy that the telephone men believe in."

In the past few years one of the Western plant engineers of a leading local telephone company in that vicinity reported that he had tried many different ways of filing large record tracings, such as the use of drawers, large tubes, etc.

In either case, they found the tracings wearing and tearing in a short time, due to the fact that in drawers the large tracings became wrinkled. In tubes the tracings invariably are not rolled tightly enough, and in filing they are torn. Another objection to the tube filing was that the edges of the tracings were curled so tightly that it was almost impossible to flatten them out.

More than this, they found that by filing the tracings in either of these two ways it was necessary to keep mounted prints of their cable charts for daily reference. This was not considered advisable on account of the double expense of daily posting both the map and the tracing.

After giving these two plans a thorough try-out, it was believed that a considerable saving of time and expense could be effected if some kind of cabinet could be built in which the tracings could be filed so that they could be referred to quickly and used instead of the mounted maps. As a result, the cabinet shown in the illustration was designed and adopted.

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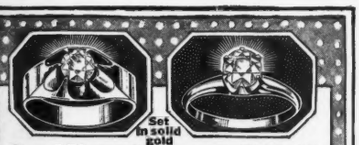

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In this cabinet the tracings are laid upon a tagged manila paper which keeps the tracings perfectly flat, both sides of the paper being folded over the tracing and bound tight with eyelets. The bottom of the tracing is left loose and flush with the edge of the paper. The top of the paper is folded over the tracing about two inches, and both are attached to two sticks fastened together with short stove-bolts which are countersunk, leaving the sides of both perfectly smooth. They are then slid on light metal tracks, which are made so that there will be two rows of tracks, upper and lower.

Each map is numbered across the end of the stick, and can be easily located by referring to the index.

Tracings filed in this manner may be removed and hung on the side of the cabinet for reference purposes, or they may be laid flat on a table and worked upon, the same as a mounted map.

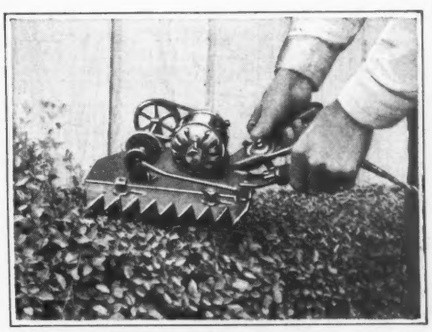
Tracings can be used in this way, with all information posted thereon, and can be replaced when worn at small expense, as compared with the time and expense of mounting. In addition, there is the saving in postage on the map and tracing.

Real-estate concerns, sales departments that keep on file many maps, and all sorts of firms will find this cabinet and filing system readily adaptable to their needs.—EVERETT COREY.

The Electric Hedge-Trimmer Does Work in Jig-Time

PROBABLY tired of the unending job of trimming his hedges by hand, William Combouzou, of Baton Rouge, La., has devised an electrically operated hedge-trimmer. The trimmer has a reciprocating knife-blade somewhat resembling, on a small scale, the knife-blade of a mowing-machine. This blade operates as long as an electric button is pressed.

The hedge-trimmer has two handles, a base-plate, a stationary blade, and a



Plain and fancy hedge-trimming can be done with this instrument without fatigue

reciprocating knife-blade. An electric motor is mounted on the base-plate, and is connected with the movable knife-blade to operate it. A pulley carried by the motor is connected by a belt to a larger wheel, which in turn is connected by a crank with the movable blade to accomplish its back-and-forth motion.—L. L. SARGENT.

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"What other men have done with the help of the International Correspondence Schools, I can do. If the I. C. S. have raised the salaries of other men, they can raise mine. If they have helped others to advance, they can help me. To me, I. C. S. means 'I CAN SUCCEED.'"

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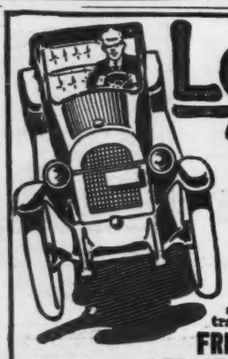

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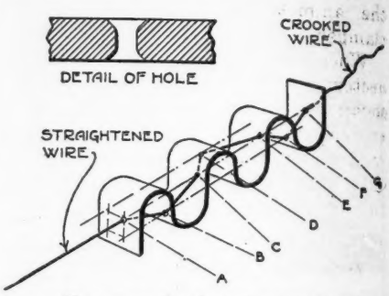
SMALL copper wire for winding magnet coils should have all the kinks removed from it, and should be held at constant tension while winding, in order to keep the wire in any layer from sinking in between the turns of the preceding layer, thus introducing irregularities in the winding and a consequent waste of winding space.

The device shown in the sketch, made from an 18-in. piece of band-iron ⅛ by 1½ in., will achieve both of these objects. As will be seen, holes *A*, *C*, *E*, and *G* are in line with one another. *B* and *F* are below this line, while *D* is an equal distance to the left of it.

As the wire is drawn through the seven holes, it is straightened in two different planes. This will work out many small kinks that would not be caught by ordinary means in use for the purpose among amateur electrical



You can make that wire straight and tight by using this device

workers. With the added advantage of holding the wire at a practically constant tension, the straightener becomes particularly effective.

The holes should be counter-sunk on both sides, and rounded off with a round file, so as not to tear the insulation on the wire. The holes can be laid out and made while the bar is still flat; but this involves quite a job of drafting, and, unless one is proficient at this kind of work, better results will be obtained by bending the bar to shape, then marking the centers for the holes, and unbending the bar sufficiently to get at the centers with the drill-press.—H. N. KRANER.

Dry-Cleaning the Spots from Draftsmen's Tracings

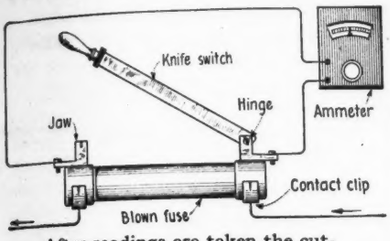
GREASE-SPOTS or other dirt, which give to tracings a very soiled appearance, may be cleaned off with a little kerosene or gasoline correctly applied.

Tack the tracing to a drawing-board, and then apply the liquid gently but liberally to the surface, allowing it to soak in, after which dry it off with a clean cloth.

The other side of the tracing should be treated in the same manner. When dry, it will be found that the polish will not be removed from either side of the tracing.—PETER J. M. CLUTE.

A Shunting-Out Switch for an Ammeter

A CONVENIENT shunting-out switch can be fitted on a blown fuse and connected as shown in the accompanying illustration. When the



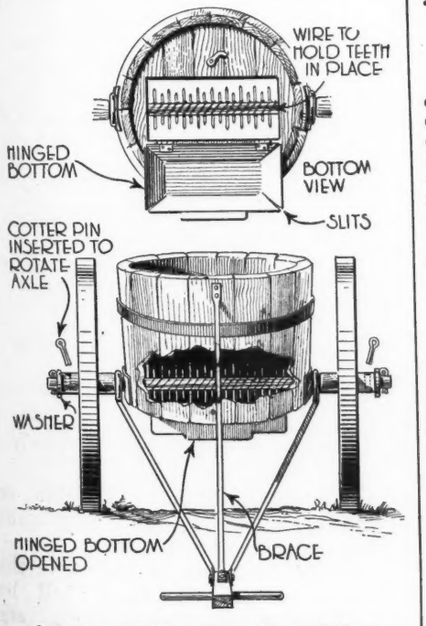
After readings are taken the cut-out terminals are again shunted

switch is closed, the ammeter, connected across the dummy-fuse connector, is shunted out of the circuit. The hinge and jaw of the switch are respectively soldered to the ferrules of the blown fuse, while the leads to the ammeter may be soldered or clamped on the ferrules.

When inserting the dummy fuse-connector in a live circuit, arrangement should be made to shunt the circuit around one of the fuses by placing a jumper between its terminal clips. Then the fuse is pulled out and the dummy fuse-connector inserted.

It's Easy to Make This Manure-Spreader

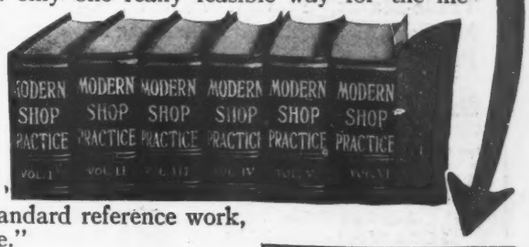
THE illustration shows a machine that is easily made from parts picked up about the farm. It will replace the work of two or three men hauling manure to the garden in buckets. Utilizing very little room, it can be wheeled into any size garden, no matter how small.—JAMES MONTGOMERY.



A device of this kind is easily made from parts of tools found about the farm

Can You Answer these Questions on Shop Work?

THE skilled mechanic today is a specialist. He has no opportunity to build a complete machine or even a small part of one. His active work is carried along rather limited lines. But to make the best success in his work—to secure promotion to more responsible duties or to go into business for himself—it is absolutely necessary that he have a broad and comprehensive knowledge of machine work and shop practice. There is only one really feasible way for the mechanic to familiarize himself with other shop lines outside his own individual work—and that is to have specialists in all lines give him all they have learned in a form that will be readily accessible. There you have the reason for the famous standard reference work, called "Modern Shop Practice."



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A surface of cast iron is to be finished in one cut on a milling machine. The casting is 8 inches long and 5 inches wide. The milling cutter has a diameter of 3 inches and a width of 2 inches. How long will it take to do the work? Assume a feed of 2½ inches.

For what purpose is a magnetic chuck used?

How many processes for cutting gear teeth?

How do you determine the ratio of two gears, when the numbers of teeth are given?

The lead screw has a pitch of ¼ inch. What is the ratio of gears to be used to cut a screw with 18 threads per inch?

What determines the cutting speed in a milling machine?

Give a short description of the thermit-welding process.

What is essentially the first step in making any tool from a toolmaker's standpoint?

Why is it advisable to cut the threads of an adjustable tap somewhat smaller than the desired size for the tap to cut?

Under what circumstances would you consider it advisable to use a counterbore, rather than a drill when enlarging a hole? Why?

Why should undue accuracy never be indulged in when making drill jigs and similar tools?

What is the practical way to test the temper of molding sand?

How does the riser on a steel casting differ from one for iron?

What are some of the precautions necessary in pouring a mold in order to obtain the best results?

How are the sides of deep molds vented when a flask is used?

What point carbon steel should be used for machine tools, milling cutters, drills and taps?

Why is it necessary to reheat large pieces after they have been hardened?

What must be the outside diameter of the original wooden pattern for the rim of a pulley with six arms, the diameter of the finished pulley to be 30 inches and the width of face 9 inches?

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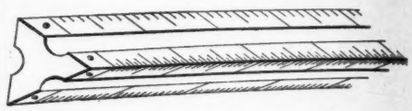
Any Draftsman Can Make This Scale Protector

TO a great extent the flat scale, with measuring divisions on one side, has superseded the triangular one for engineering work; yet the latter is still in use, and seems destined always to occupy a place in a draftsman's kit. A triangular scale in use rapidly



Here's an idea for draftsmen: save the scale by raising it above the work

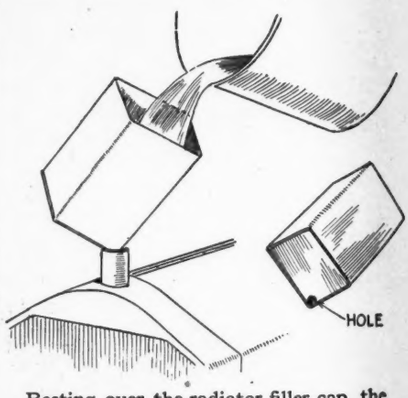
wears along its six measuring faces, and in a short time the edges become irregular and worn from constant contact with the drawing-board. Here is a simple method for keeping the faces from rubbing. The method is self-explanatory.

Common pins are cut off about 1/16 in. from the head; pin-holes are made on the faces of the scale, in the margins that are always left on the ends, and no enumerations are disfigured. The pin stubs are driven into these holes on each end. As is evident, the scale rests on the pin-heads, which keep the faces about 1/16 in. from the work.

This idea can also be applied to the flat scale with measuring faces on both sides. It is a great saver of scales. Why doesn't some enterprising manufacturer provide something of this sort?—ERNEST SCHWARTZ.

The Ever Useful Rough-and-Ready Tin Can

WHEN the real article is not around, an easily made substitute for a funnel can be made ready in



Resting over the radiator filler-cap, the contents of the can flow smoothly into it

a minute or two by simply knocking or punching a hole in the lower right corner of a square tin can.

If held diagonally, as shown in the illustration, this makeshift will be found to answer the purpose very well.—MORRIS G. MILLER.

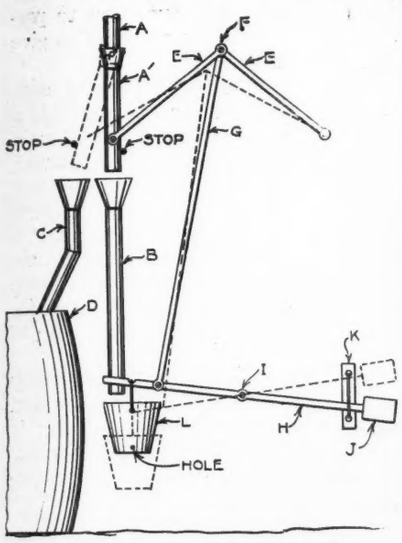
A Separator for Purifying Cistern Water

THE device here described is based on the fact that rain-water, when it begins to flow from a previously dry roof, contains more or less refuse that has been collected on the roof and in the gutters. The apparatus side-tracks the first one or two bucketfuls containing the dirt, then automatically shifts to the regular container.

A short length of rain-pipe, *A'*, fitted with a flaring upper end, is pivoted to the bottom of the main rain-pipe, *A*. This allows *A'* to swing from right to left in a small arc.

Directly beneath *A'*, when hanging vertically, is fastened the length *B*, which is clamped to the side of the building. A wide funnel-shaped receptacle at the top receives the flow from *A'*.

Another pipe, *C*, is then placed



This efficient idea for keeping rain-water clean originated in Australia

alongside of *B*, and is arranged to empty into a barrel or cistern, *D*.

A toggle, *E*, was then made of two hard-wood sticks of equal length pivoted at *F*. One end was then pivoted to the lower end of *A'* and the other end to the side of the building. All pivots should allow free movement.

A connecting-arm *G* extends from *E* down to a lever *H* pivoted in the center at *I*. The end near pipe *B* is provided with a notch upon which can be hung a large bucket, *L*. The outer end is then counterbalanced so as to tip the lever when the bucket is nearly filled. When empty or only partially filled, the weight *J* remains down, as shown.

When the first flow of water descends through *A'* it flows down into the bucket. When this is filled it drops down, pulling upon the toggle, which pushes *A'* over the pipe *C* and discharges the water into *D*.

Two stops at required points prevent *A'* from going beyond either position.

A guide *K* also assists in regulating the distance through which the toggle works.

The bucket empties through a hole near the bottom.—L. B. ROBBINS.

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A Tent Frame Made of Pipe

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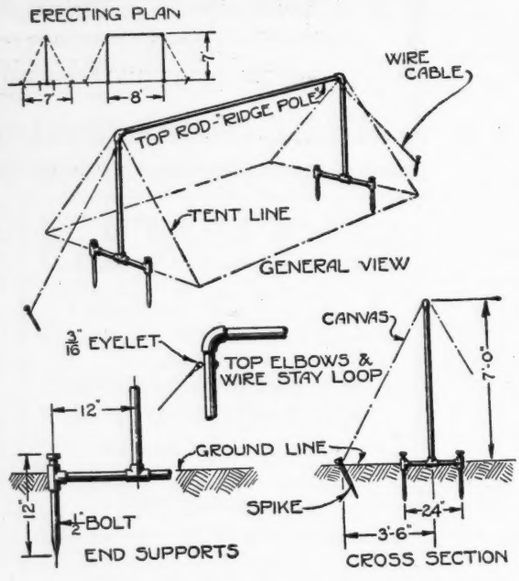


The frame is made of pipe and fittings, and is held to the ground with iron stakes driven through the openings

It is best to procure galvanized pipe and fittings or, when complete, apply a thorough coat of enamel. The canvas may be purchased in two pieces and joined together with 2-in. hems and then given two good coats of the best linseed oil, allowing the first coat to dry thoroughly before applying the second coat.

The eyelets or button holes are made by cutting a slit near the bottom hem 1½ in. long and overhanging the edges. Through these slits, which should be 9 in. on centers, the covering is fastened to the ground with 10-in. by ½-in. square-head bolts, leaving the threads on them intact for holding them in the ground securely.

The flaps for the front and rear may be made detachable by use of ordinary automobile side-curtain buttons of the snap kind. A piece of sheet celluloid may be sewed in the front and rear flaps to give light inside on stormy days. At the top center of the canvas a 3-in. strip should be sewed on to prevent wear and also to give additional strength.

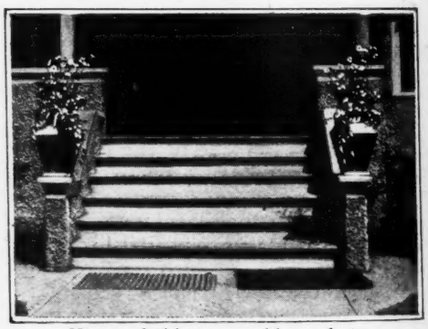
The tee fittings at each end of the legs provide a very ingenious way of holding them to the ground, for in driving an iron bolt through each one a quick and efficient erection is accomplished. Use a chain or a 3/16-in. wire cable on each end, with a loop at the bottom for a sharpened bolt to hold it in place.

For convenience a wood floor may be made of ⅞-in. pine boards, hinged together in four sections so that it can be folded up and carried under the arm or easily packed when traveling.—P. P. AVERY.

Every Man His Own Vase-Maker

A PORCH vase that will harmonize with the present mode of stucco construction, as well as with a frame structure, can be made by the average handy man. It is a four-cornered vase, and is in effect a Greek vase squared. Definite dimensions are obviously out of the question where the vases are to fit some individual porch. These general directions should be followed, however.

The greatest width of the vase will come anywhere from two thirds to three quarters of its height. This greatest width should exceed the width of the base by at least one third. The opening at the top should be somewhat smaller than the base. Straight saw cuts only need be employed in the construction of this vase. Four pieces will be required for the bottom half of the vase and four pieces for the top. The dimensions are easily obtained, though it must be borne in mind that two each of the top and bottom pieces will have to be cut narrower by an amount sufficient to compensate for the thickness of the wood utilized. Otherwise the vase will not turn out to be square. It is best to use inch lumber, but the rim around the top and the handles may be made of two-by-two pieces. The completed vase may be given a coat of cement or thin stucco.

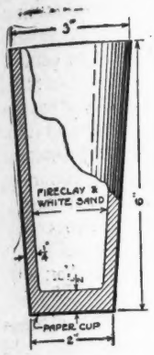


Vases of this type add much to appearance of the house entrance

The construction of this vase amounts only to the nailing together of two square boxes, the upper one being less than one third as high as the lower one, with the sides of both extending outward in the manner of a hopper. A vase of this kind is very durable, and if emptied of all soil during the winter will last many a year.—C. L. MELLER.

How to Make a Crucible of High Temperature

DUE to their high price, very few amateur experimenters possess crucibles capable of withstanding any great heat without melting. By using the following method, crucibles capable of withstanding exceedingly high temperatures can be made at a fraction of the market price.



A paper cup provides the form for the crucible

The essential ingredients of the refractory substance of which the crucible is composed are fire-clay and white sand—the kind found at the sea-shore is the best, but any good sand will do. The fire-clay and the sand are mixed together, half clay and half sand, with enough water to make the mixture workable.

The mixture is plastered on the inside of a paper cup, sides and bottom. The sanitary drinking-cup of waxed paper is excellent for the purpose.

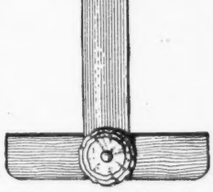
The sides, for a crucible 6 in. in height, 3 in. in diameter at the top, and 2 in. at the bottom, should be not less than ¼ in. thick, the bottom not less than ½ in. Of course the thickness varies with the size of the crucible.

While the lining is still wet, make a notch in the top edge. This takes the place of a spout, to guide the molten metal as it is being poured from the crucible into the mold.

Let the crucible stand for a few days until it is dry; then burn off the paper cup.—ARTHUR KENNEDY.

Rendering the Draftsman's T-Square Doubly Useful

THE mechanical draftsman often finds it necessary to wipe his ruling-pen while he is engaged in holding the T-square and triangle in position with one hand. This produces an awkward situation, but perhaps the following suggestion will serve to overcome the difficulty.



Fastened in this position the blotter is at hand when wanted

With a thumb-tack or by some other method secure a common rosette pen-wiper to the head of the T-square, and the trick is done.

By this method it is always near at hand upon the drawing-table, and can usually be reached from any position.—L. B. ROBBINS.

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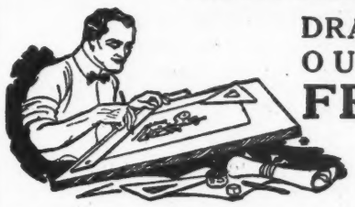

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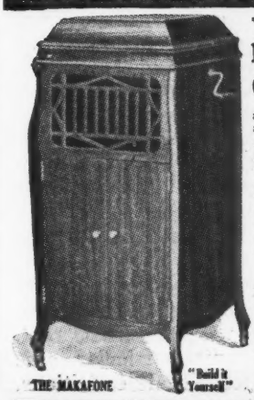

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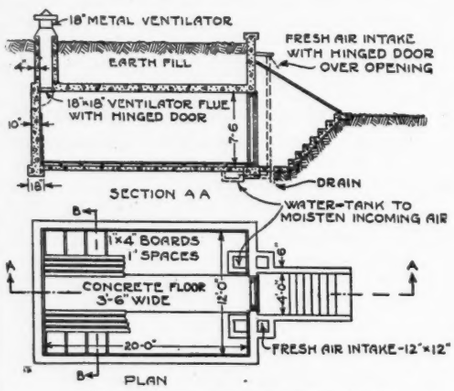
Storing Your Surplus Vegetables

By Fred Telford

MANY an amateur gardener, cultivating intensively his acre or half-acre plot of ground, has made the surprising discovery that his crop is too great for immediate consumption. Immediately he is confronted with the problem of selling or storing his surplus.

The simplest method of storing is in the earth pit, familiar to our fathers before the day of cold-storage plants. The spot selected for the pit should be on the highest part of the garden plot, and well drained. In most cases, the pit, instead of being a round pile, should be not to exceed 3 ft. wide at the base, and as long as necessary to store the crop.



The concrete storage cellar built above ground is the least expensive

Another method of storing vegetables is in the cellar underneath the house. Usually the cellar is either too damp or too warm to serve as an ideal storage cellar.

However, it may be cooled off in the early fall by leaving the door open at night and closing it in the day-time, and a very satisfactory temperature maintained throughout the winter, unless a stove or furnace is placed in the basement for heating purposes. Even then, by walling off a corner, vegetables may be kept very well. A concrete cellar underneath a house will prove very satisfactory.

Water-Tight Concrete Cellars

Undoubtedly the most suitable method of storing surplus vegetables is in a concrete storage cellar. These concrete structures have the advantage of being permanent, water-tight, easily ventilated, and strong. Moreover, they can be built in any one of several ways, to suit the convenience of the owner, without calling in the high-priced skilled worker. The concrete storage cellar built above-ground is least expensive, but it is also the least satisfactory.

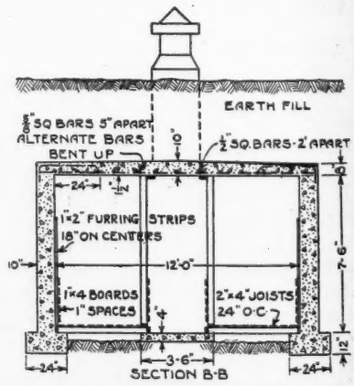
There are two types of concrete storage cellars—that with the round roof, and that with the flat roof. The choice in any particular case will depend upon local conditions, the desires of the builder, and the kind and amount of vegetables to be stored.

Concrete mixed in the proportion of one part of cement to two and one half parts of sand and four parts of stone may be used throughout, except for the roof. The arched roof requires a 1-2-3 mixture and the flat roof a 1-2-4 mixture. For the flat roof reinforcing steel must be used. Bars $\frac{5}{8}$ in. square are spaced 5 in. apart, center to center, and placed one and one half inches from the bottom of the slab. Bending the ends of the bar at right angles to form a hook about 3 in. long insures good anchorage in the concrete. Half-inch bars, placed 2 ft. apart, are run lengthwise in the cellar.

Importance of Ventilation

The ventilation of the storage cellar is highly important. In the plan shown, the cold-air intakes located at each side of the entrance door. The cold air entering the cellar passes through and upward around the stored contents. The warm air is drawn off through the ceiling by the roof ventilator. In this way the circulation of the air is complete, and in the course of one night the air is changed several times. Early in the fall the cellar is cooled by the ventilators, which are closed during the day and warm nights, so as to keep the cold air in the cellar.

Moist air is essential for proper storage of vegetables, and for this reason the plans show tanks built at the bottom of the cold-air intakes, just inside the wall. The incoming air, passing over the tanks, picks up moisture. The owner, by observing the crispness and plumpness of the stored vegetables, or by noting whether there is shrinking or shriveling, can tell whether the air is sufficiently moist.



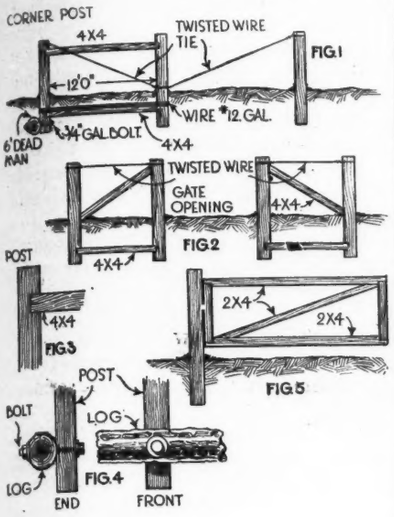
This type cellar is beneath the ground and has a ventilator projecting upward

The plans are sufficiently detailed to enable anybody who has had even slight experience in building operations to build for himself a suitable concrete storage cellar.

Five Ideas on Bracing Up Old Fences

THE illustrations show the proper way to brace up old farm fences and need very little explaining.

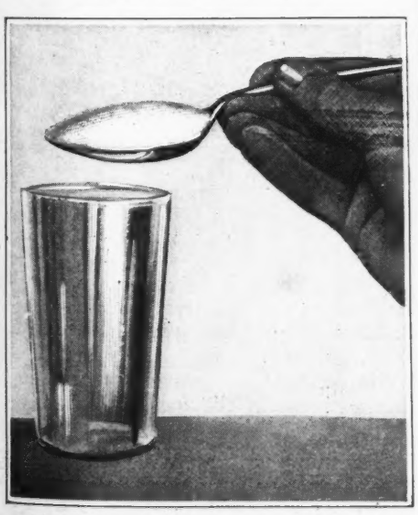
Fig. 1 shows a corner as it should be braced, while Fig. 2 shows the proper



No need of those staggering and deformed fences that detract from the appearance of so many people's property

bracing at a gateway. Fig. 3 shows a detail of the bracing and securing together of the corner post and the "deadman" which prevents it from "kicking out." Fig. 5 shows the proper position of the diagonal brace in a gate, the brace being placed so that the weight of the gate is pushed in toward the bottom hinge. If this brace is reversed—and all too often it is—it is useless, as it simply adds weight to the gate.—GEORGE M. PETERSEN.

Figure Out Why the Water Does Not Overflow



Fill the glass full of water, then pour in a heaping teaspoonful of salt. Contrary to your expectations, the water does not flow over the edge of the glass. Why?

How Fred Cline Got His Start

Began with Almost Nothing—Now Pocketing $6,000 a Year and His Profits Steadily Increasing

New 5c. Confection Did It

Says Anyone Anywhere Can Do As Well—No Experience Necessary

A good many men who know Fred Cline would like to be in his shoes. They envy his success. But he hasn't always been envied. Time was when he was barely earning a living.

Saving money out of the meagre wages he got in those days was almost impossible. He had practically nothing laid aside. But it was enough to give him his start; enough to set him up in business for himself—a new kind of business that has proved a regular little "gold mine."

That was only a few years ago. Today Fred is making around $6,000 a year—and his profits are steadily increasing. While he doesn't work half as hard as he used to, he is pocketing more every day than he formerly earned in a week. In his own boss—doesn't have to take orders from anyone. Has bought a fine home—all paid for. Rides around in a $2,000 car. Has a substantial and growing bank account. Enjoys many other comforts and luxuries that a few years ago he scarcely even dreamed of.

How did he do it? No previous business experience—had been a plain workman. Had only a common school education. And he himself would be the last man in the world to credit his quick rise to prosperity to any special genius or ability on his part.

Some may say he was lucky. But it wasn't luck. Proof of that is the fact that hundreds of others, both before and since, have put themselves on Easy Street in exactly the same way he did.

Here is the whole secret. It was a money coining machine that piled up Fred Cline's profits, that built his his house, that paid for his car and other comforts; a patented machine that almost automatically builds up a fine business by making the finest 5c confection that anyone ever ate—a wholesome, delicious and entirely different new kind of pop-corn candy that people grow wild over wherever it is introduced. It is called Crispettes—so tempting to look at, so appetizing in its delightful odor, so betwitching to the taste—that it literally turns into money as fast as it can be made.

Fred Cline deserves full credit for his success. He was quick to see his opportunity and quick to seize it. But when you know the facts, it is easy to see why Fred has prospered. Regardless of age, practically everybody has a sweet tooth—men, women, children. Crispettes appeal to this universal sweet tooth in a way that is simply irresistible. You can't see them or smell them or taste them without feeling "hungry" for them. Unlike chocolates and other "heavy" candies, they don't tax the digestion. You can't eat enough Crispettes to hurt you. People never get tired of them. That means steady come-again customers.

They are only 5c a package—an amount that is easy to spend; where there is one person who can afford high-priced candies, there are hundreds who will buy at 5c. Nickle sales to the many will always beat dollar sales to the few. On a good day Crispettes sell about as fast as you can hand out the packages and take in the money. They almost sell themselves. The mere sight or smell of them makes the mouth water—and makes a person reach for a nickel.

Now Owns a Fine Home

The Crispette Machine can turn out as high as eight hundred 5c packages an hour $40 every hour. Nearly 4c out of every nickle you take in is clear profit—about 76c out of every dollar. The ingredients are nothing but popcorn and syrup—but cooked and blended together by a special formula that brings out an enchanting new flavor that people say is the most delicious they ever tasted.

There is only one way to make Crispettes—that is on the patented Crispette Machine. The process is almost automatic. Special secret formula included with the machine. Also full instructions for building up a profitable business right from the first day, either retail or wholesale or both—the tried and proven ideas used by scores of others already in the business. I show you how to draw crowds—how to cash in on fairs, picnics, holidays, etc.—every step made easy so you can't go wrong. No experience necessary. The Crispette Machine, the Crispette formula and the instructions are all you need. Small sum buys the complete outfit. Don't even have to open a store. Can do business from your home or rent part of a store window. The Machine in a window is a great salesman—attracts attention—brings in customers. And there are many other advantages.

No wonder Fred Cline is making money. But he isn't the only one. Crispette Machines and the delicious candy they make are piling up fine profits for hundreds of others. Listen. An inexperienced boy "cashed in" $1,435, the first five weeks. A former clerk in a railroad office got his start in the Crispette business and is now wealthy. Another man made $400 net in one week. A former printer sold $22,000 worth of Crispettes the first seven months—figure his profits for yourself. Another man made over $500 in a single day. Another $700 **ahead** in less than two weeks. And so it goes.

Bought This Car From Profits

CASH IN ON PROHIBITION!

Think of the millions of dollars heretofore spent for liquor! After July 1st it will go for other things. The Crispette business will be the first to profit. Towns previously dry show that men who can't get liquor turn to Crispettes by thousands—they crave sweets—and Crispettes make a hit because they can be eaten all day long without hurting anyone. Prohibition also gives children more nickles to spend. Investigate now—don't wait until someone else seizes this opportunity.

This is a big country. There are still thousands of towns and cities waiting for some live man to start up in the Crispette business. Big money-maker by itself or can be handled in connection with other business. Every town of 1,000 people or more means an opportunity. Maybe here is exactly the chance you yourself have been wishing for. Why not at least look into it? Just send me your name on the coupon below and I'll send you all the facts and figures so you can judge for yourself—including the names and addresses of all the men mentioned here, with letters from them and others backing up everything I say. But send the coupon **now**—before you have a chance to forget—and before someone else in your town beats you to it. A postage stamp is all it costs to get the facts—that is all you have to risk to find out about a money-making opportunity that may mean prosperity for the rest of your life.

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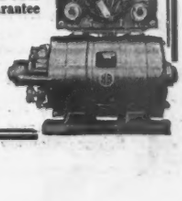

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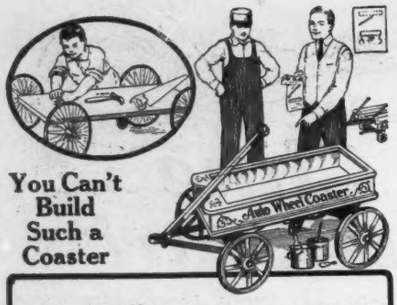

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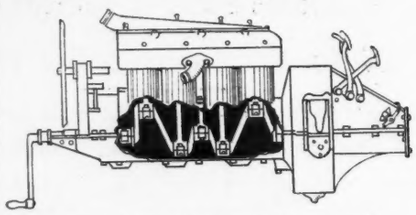
Keep Your Eye on the Engine Bearings

By G. F. Collins

THE average overhauling of the repair job on a Ford is directly traceable to the owner's neglect to take the proper care of his car from the first day he bought it. Every little "loosening up" should be stopped in the beginning, before it has developed, which will necessitate constant watchfulness and an all-round "tightening up" that formerly was done every so often, when



An engine knock is a boost if you catch and remedy it before trouble occurs; an alert owner watches his car constantly

the owner finally got to it. It is now recognized by the alert owner as part of his daily duties while driving his car.

These first principles may sound a little difficult, but they really are simple and practical and become second nature in a very short time.

Getting at the Bearings

In obtaining access to the Ford connecting-rod bearings, the crank-case cover must first be removed, taking out the fourteen cap-screws, at the same time carefully watching the gasket as the crank-case loosens, to avoid its being torn or destroyed. It is not necessary to remove the oil from the crank-case, since the normal oil level is below the detachable plate on the bottom of the crank-case.

Loose connecting-rod bearings will cause a rattle and knock at light loads and a high speed, but a heavy load seems to steady them.

Remove the first connecting-rod cap, and file the ends, a little at a time; then replace the cap, and tighten the bolts until it fits the shaft snugly. This feature can be tested by turning the engine over with the starting crank. After this operation is completed, loosen this bearing and proceed to fit the others in the same manner.

The Bugbear of the Ford Engine

No. 4 bearing is the bugbear of the Ford engine for those who do not understand its proper method of removal.

The fourth connecting-rod is brought up nearly half way on the up-stroke by the use of the crank. The cotter key and nut are then removed and the crank-shaft turned over until it is half way down on the other side. Then the other cotter key is pulled out and the nut removed from the bolt.

It is advisable to mark the connecting-rod cap with a center punch before taking it off, because in this way it can easily be replaced in its former position.

Finishing Touches

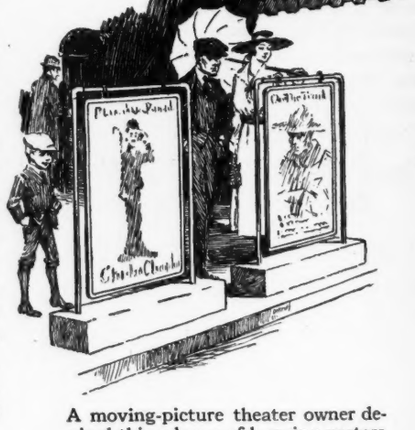
After the proper adjustments of the bearings are assured, they should be carefully cleaned and lubricating oil placed upon them. The bearings should not be drawn up too tightly, since if such a condition is secured there is a possibility of the babbitt cutting out.

The engine should be run slowly until the new adjustments are able to adapt themselves. In returning the crank-case the gasket should be replaced by a new one if it is the least bit worn or torn. Oil leakage at this point may later cause serious damage.

And, last but not least, a few minutes spent each day in making minor adjustments will make you proud of your car.

A Portable Poster-Hanger for Theaters

A LIVE-WIRE moving-picture theater owner in a flourishing neighborhood devised a sidewalk poster-hanger in which he inserts posters advertising the various films he is



A moving-picture theater owner devised this scheme of hanging posters in gaspipe frames set in concrete

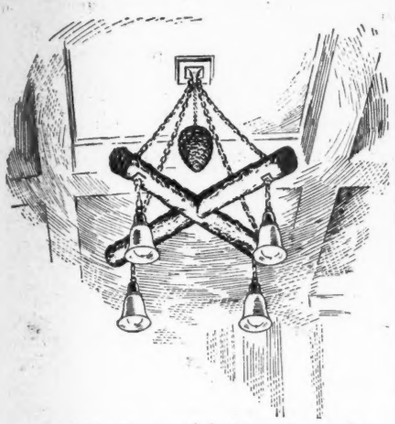
showing. These hangers may either be set along the curb-stone in front of the theater or else placed in the lobby.

The bases of the hanger are made from concrete in the form of a rectangular block about 12 in. high by 18 in. wide and from 4 to 5 ft. long. The uprights or hanger stays and the cross-top hanger are made of ordinary gas-pipe of 1½ in. diameter, which is held securely in place by being set into the concrete before it hardens.—R. O. HELWIG.

A Suggestion for Lighting a Club-House

THE sketch below illustrates a very attractive and easily made lighting fixture suitable for a club-house or restaurant.

The main members are about 3 in. in diameter, and are of natural wood,



An aid to the restful atmosphere of the club-room is this type of fixture

no finish being applied to the bark. All of the shades are of the bell pattern, either frosted or amber-colored. The supporting chains and rings are of iron painted a dull black, as are the sockets.

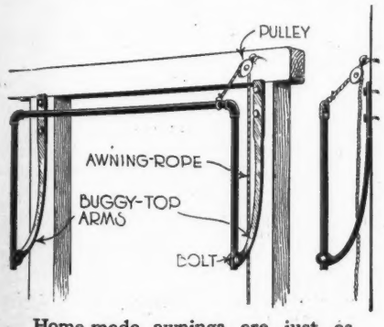
From each light the wiring is run up through the chain to the upper side of the log, where a long slot is cut for the main feed wires, which are then interlaced through the two supporting chains and pass out through the ceiling block.

The only decorative feature consists of large pine cones about 8 in. long, which, when suspended as shown in the picture, add greatly to the general effect.—JOHN ADAMS.

Turning the Buggy-Top into a House Awning

WITH parts from an old buggy-top, some pieces of pipe, and two elbows, a farmer constructed the folding awning frame here shown.

It needs no explanation other than the illustration, and proves once again



Home-made awnings are just as good as the expensive bought kind

that seemingly useless material may be used to good advantage if foresight is brought to bear upon the problem in hand.—JAMES M. KANE.

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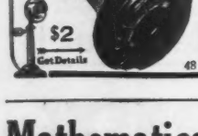

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What Can You Do with a Hairpin?

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WHAT do you do with a hairpin? Throw it away? Give it to your wife or sister? We happen to know that hairpins are invaluable around a Ford car. There are, of course, more uses for them, and we want to know in how many practical ways they can be applied in the home and in the shop. Tell us! The POPULAR SCIENCE MONTHLY offers three prizes,—a first prize of $25, a second prize of $15, and a third prize of $10,—to be awarded in accordance with the rules set forth below:

Rules Governing the Contest

(1) Contestants are not limited to the number of methods of utilizing hairpins which they may describe. But only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method of using hairpins must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol-board. The views should be sufficient in number to set forth the use of hairpins very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method of utilizing a hairpin is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on June 30, 1919.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $25 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of utilizing a hairpin.

The second prize of $15 will be paid to the contestant who submits a method next in merit.

The third prize of $10 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of POPULAR SCIENCE MONTHLY. A description of the methods which won these three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious methods of utilizing hairpins which do not win a prize. The regular space rates will be paid to the contestants who submit manuscripts on the methods thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) No manuscripts or drawings will be returned to contestants.

(11) Send drawings and specifications to the Hairpin Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

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Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for April 1, 1919. State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Loren Palmer, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2.—That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3.—That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: Importers and Traders National Bank, 247 Broadway, New York, N. Y.; H. J. Fisher, 22 William Street, New York, N. Y.; Geo. H. Mead Company, Dayton, Ohio. 4.—That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. CAPEN, *Business Manager.*

Sworn to and subscribed before me this 20th day of March, 1919.

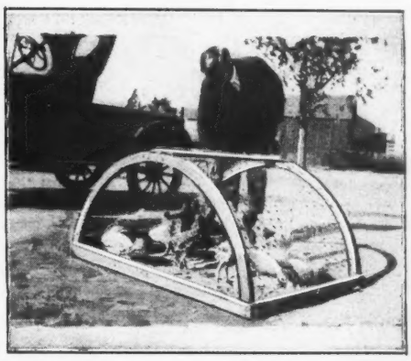
Robert A. Macbeth, certificate filed in New York County. (Seal). My commission expires March 30, 1919.

Give the Chickens a New Outlook on Life

A LOS ANGELES man has devised a portable chicken-coop.

He uses felloes, or rims of buggy wheels, as part of the framework, attaching them to a square frame that forms the bottom of the coop. A strip of wood attached to the sides of each rim holds the wire in position.

The frame is covered with wire netting, which is an advantage, as it allows

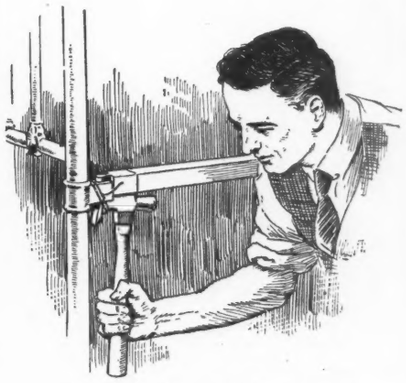


Now comes the portable chicken-house which provides variety for the inmates

plenty of sunlight to reach the chicks. The coop is very light in weight, making it easy to transfer from one spot to another.—CHARLES WAGNER.

Taking Apart a Stubborn Iron Bedstead

WHEN it becomes necessary to take an iron bedstead apart, it will sometimes be found that the side rails are wedged in so tightly that they must be hammered apart. An iron hammer should never be used unless a block of wood is held against the part



A little patience, a little wire, and a hammer will do the trick

to soften the blow, for cast-iron breaks very easily.

A good way to disengage the parts is to wire the claws of a hammer to the foot- or head-rail with a few turns of heavy wire, and then push on the hammer handle just as if you were pulling a nail. The rail comes out quite easily without any danger of breaking.—V. H. TODD.

Are YOU a FREAK?

You've seen them often at the bathing beaches, skinny and flabby, stoop-shouldered, lop-sided, all their physical imperfections displayed in bathing suits. No wonder ridicule follows them, whenever they take off the clothes that make them look like men. *How about YOU*—when you put on a bathing suit? Have you the upright carriage, evenly developed muscles and clear, glowing skin that indicate health, vigor, *virility, MANHOOD?* Don't be a caricature. Even if you are sickly, weak, puny, you can get rid of your ailments, overcome your weakness and repair yourself, *if you go about it the right way.*

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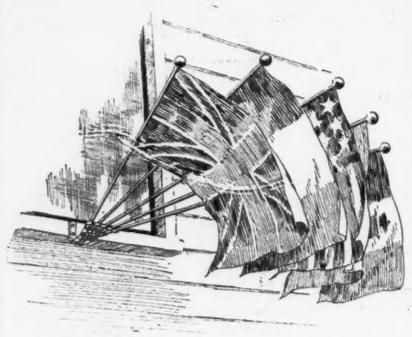
Make an Adjustable Flag-Holder

FLY-TIME is coming, and many houses are fitted with flag-holders screwed to the window-sills. These cannot, of course, remain if screens are to be fitted.

To overcome this difficulty, angle-irons may be purchased from any hardware store, and two holes bored in

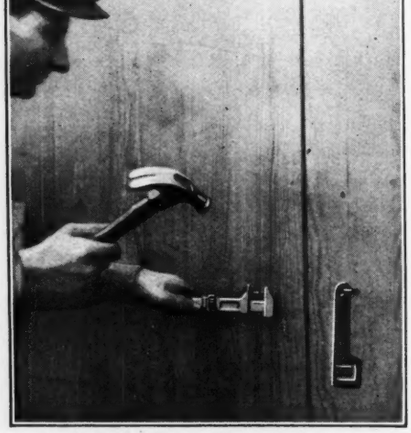


With this attachment for your flags the flies cannot enter the house

the lower part to fit the removed holder. It may then be screwed to the vertical part of the window-sill and the screen slid up and down without interference.—JAMES M. KANE.

Reconciling the Hasp and the Barn Door

IN applying hasps, hooks, staples, etc., to a barn or garage door, it will be found that the large staples used for this purpose usually spread before they can be driven into the wood, causing bruised fingers and general discomfiture



Try this method on that elusive hasp and you will save time and temper

to the would-be carpenter and anybody else in the vicinity.

To avoid this difficulty you can start the staple into the wood, then adjust a large monkey-wrench so as to fit against the sides of the staple as illustrated.

By holding the wrench in place the staple can be driven as deeply as desired.—V. L. SNYDER.

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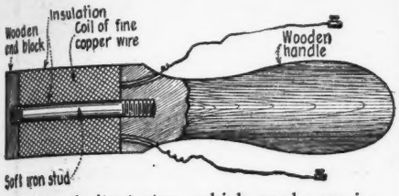
How to Test the Polarity of Electric Machines

A POLARITY-TESTER working on induction principles may be very easily constructed, as is demonstrated by the accompanying illustration. When in use the leads of the testing coil are connected to a direct-current millivoltmeter; or, if such an instrument is not at hand, an ammeter, having its shunt disconnected, may be employed. A low-reading voltmeter



This polarity-tester, which works on induction principles, is very easily constructed

may be utilized, provided the testing coil is composed of a large number of turns of fine copper wire.

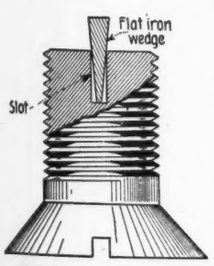
If the coil is moved toward an excited field magnet, the voltmeter needle will register a momentary deflection in a definite direction, depending upon the polarity of the field coil under test. A slightly greater deflection will be noted if the testing coil is first slowly approached toward the excited field magnet and then quickly withdrawn.

Thus, by testing the polarity of the poles around a direct-current machine in rotation, it is evident that an incorrect connection can be quite readily determined. By exercising sufficient caution in operation, this device may be employed to test the polarity of adjacent poles on a machine in operation.

This device may be used in any size to suit the specific need, the only requisite being that the coil should consist of not less than 500 turns of insulated fine copper wire, so that the inductive kick on the meter will be appreciable.—PETER J. M. CLUTE.

An Old Worm-Screw Made as Good as New

VERY often a screw will wear too small for a hole, and in many instances a similar one of suitable shape and size is not readily available. In such a case, the old one can be used by putting it between two pieces of wood or copper in a vise and cutting a slot diametrically through the end of the screw, as shown in the illustration. A flat iron wedge is next driven into the slot, thus opening it a little. The screw can then be turned into its place, and will be found to hold as well as if new threads had been cut on it.—PETER J. M. CLUTE.



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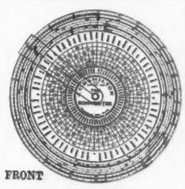

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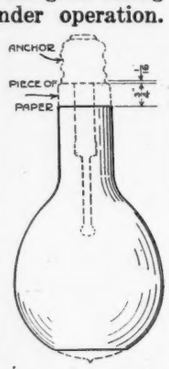
How to Use an Old Nitrogen-Filled Lamp

A THOROUGHLY satisfactory flask or wash bottle for experimental use in the laboratory can be made from a nitrogen-filled lamp which has become commercially valueless.

Paste a strip of paper about ¾ in. wide around the neck of the lamp 1/16 in. back from the anchor, so as to prevent the cracking of the glass casing of the lamp while under operation. Then, with a three-cornered file, begin filing the glass casing along the side of the anchor.



Many interesting experiments can be made with an old nitrogen lamp-bulb

Presently the top or the anchor of the former lamp comes off with the greatest ease. Remove the paper, and begin fire-polishing the top of the former lamp, and the bottom as well, gradually pushing in the tip of the lamp until it is flush with the surface. Continue fire-polishing the bottom of the lamp until it becomes slightly flat, thus affording stability to the flask.

After it cools, the process is completed and the new product is ready for immediate use.

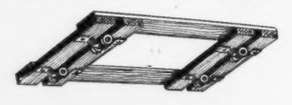
—NATHANIEL HARRIS.

Roller-Skates Run This Novel Truck

A TRUCK for use in a dry-goods store was made simply by attaching a pair of roller-skates to the proper frame.

Strap-iron cleats, bent and drilled, were made to keep the truck-frame clear of the wheels.

The frame proper is 16 in. wide and



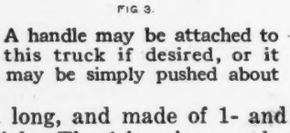


FIG 3.

A handle may be attached to this truck if desired, or it may be simply pushed about

30 in. long, and made of 1- and 2-in. material. The 1-in. pieces make loading and unloading easy, while the 2-in. pieces underneath provide a solid foundation for the rollers. The strap-irons are bolted to the center of the pairs of skates, and these, in turn, are bolted to the frame.

This truck works particularly well in close quarters, and is more easily handled than are larger, bulkier trucks.

—DALE VAN HORN.

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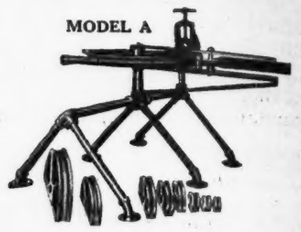

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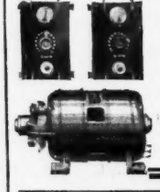

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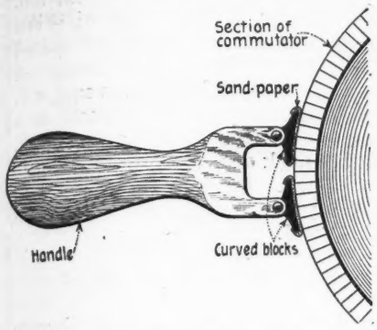
Sandpapering Commutators with a New Holder

THERE are numerous types of sandpaper-holders for dressing commutators, but they all are made



Dressing commutators is an easy matter when this device is pressed against them

with a single arc of a circle for contact surface.

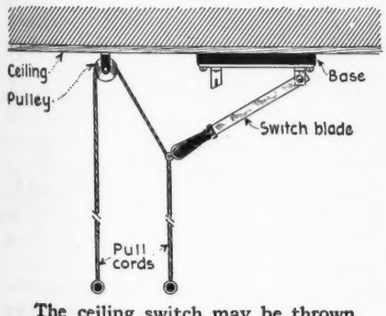
The device illustrated herewith is made to fit any sized commutator. It consists essentially of a handle which is broadened at its lower extremity, and has two blocks, 2 by 2½ in., with an arc of a circle on each face.

These blocks are pivoted, and will adjust and accommodate themselves to any commutator curvature. Either one or two of the blocks may be used, depending upon the size of the commutator.—PETER J. M. CLUTE.

A Hand-Operated Ceiling Switch

IF there is no room for a throw-switch near the work-bench, place it on the ceiling and operate the throw by means of two cords long enough to be within easy reach. In this position it is out of the way and at the same time accessible.

A single pulley is fastened near the end of the switch-base over which the pull-cord is run. The pull-cords are arranged as shown in the illustration, and at the ends are attached tags marked respectively "on" and "off." Do not

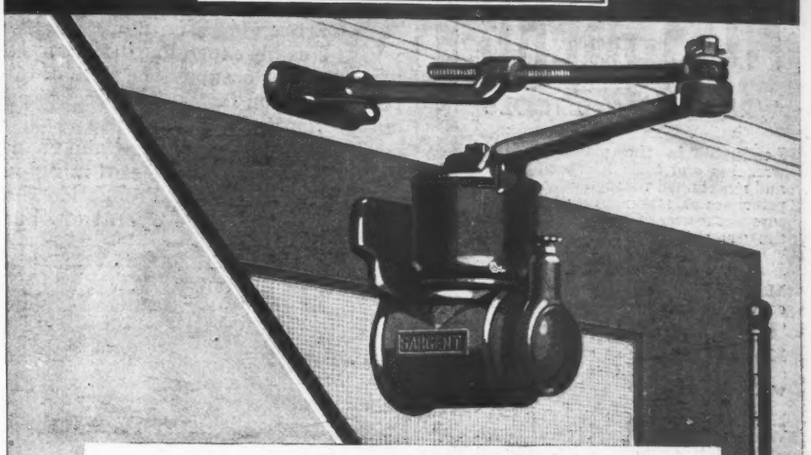


The ceiling switch may be thrown in and out by pulling on the handles attached to either end of the cord

use chains instead of the pull-cords, because there would be danger of contact with the live parts of the switch.

For convenience this arrangement can be mounted any place on the wall and the cords guided over pulleys to a point convenient to the operator.—PETER J. M. CLUTE.

SARGENT



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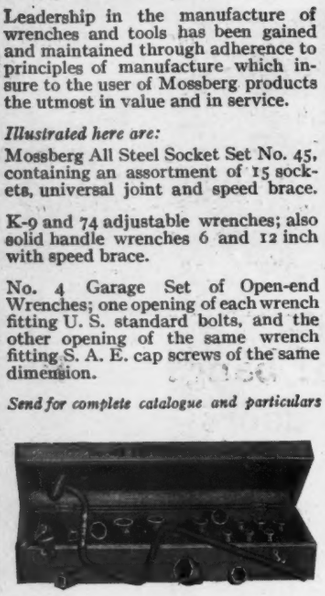

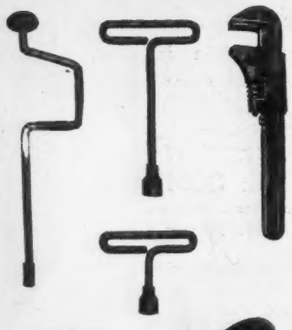

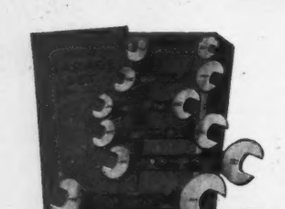

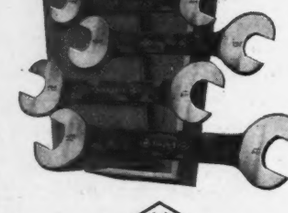

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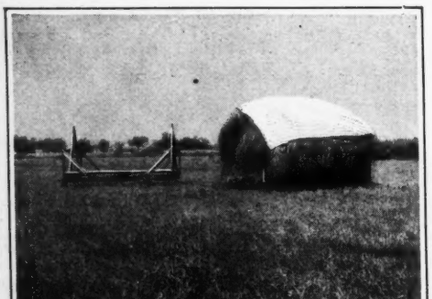
Foresight and the Hay Crop

By S. R. Winters

WHILE the hay acreage has been steadily expanding in the United States until it occupies one sixth of the tillable area on farms, its success as a crop is almost wholly subject to weather conditions. Anxiety, worry, and financial embarrassment are still mingled with saving the crop. Production is a comparatively simple operation, but



With the load of fragrant hay clear of the damp earth, this truck assures dry and perfectly cured hay

curing the hay exacts an annual cost of $125,000,000.

To minimize the hazards in the mammoth undertaking of curing an estimated production of twelve and a half per cent in excess of the average for the past five years is the object of a method devised by J. E. Evans, of Monroe County, Mississippi. It is styled the "curing truck," and its merits are suggested in its ability to support hay during the curing process, protect it from rain, render it not subject to moisture from the ground, and guarantee a product of quality even during adverse weather. Here is a description of the truck:

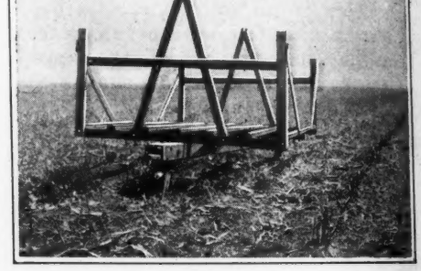
It has a striking similarity to the common hay-rack. The device is 12 ft. long and 7 ft. wide, and will hold from 1,500 to 2,000 pounds of cured hay, depending on the state of the product when loaded on the truck. The back is supported by two 16- to 20-in. steel or iron wheels running on an axle placed 4 ft. from the rear end of an A-shaped frame. These wheels can be obtained from mail-order houses.

A loaded truck not in motion, when left in the field for the hay to cure or subject to being baled, the front end of the truck is propped by a 6x8-in. block or triggers of sufficient length to hold the truck level. This wooden block or trigger is fastened between the two main frame timbers by a heavy bolt, allowing play enough for it to swing easily by its own weight. When in use it is held in position just past the vertical, by coming into contact with the front coupling casting. When the trigger is not in use, the free end pointing to the rear drags lightly on the ground.

Standards at each end of the truck run to a point at the top, in which a notch is cut to receive a 2x4-in. ridge-pole that supports the canvas and keeps it from lying flat on the hay, thus allowing air to circulate freely at the top. The bottom is made up of seven 2x4-in. pieces 12 ft. long, evenly spaced to allow the air to enter freely. A coupling device is fastened to each end. The front coupling is composed of a heavy rigid ring set in a cast-iron block, and the back one is shaped in the form of a hook for stringing together a train of empty trucks when conveying them to the field.

How the Trucks Are Moved

The trucks are moved from place to place by a two-horse team and a two-wheeled running gear similar to the front running gears, a low-wheeled wagon. A seat is attached for the driver, subject to use when the truck is transported a considerable distance. The front running gear is fastened to the truck with a long clevis-pin. When the truck is being hauled, the weight of the front end rests on the front running gear. When the team starts, the forward movement causes the trigger to trip as it passes center, and to drag on the ground, the weight of the load being thus shifted to the running gears. Upon reaching its destination the team is backed a step or two, which causes the



The curing truck as it appears set up from the ground and clear of its load

trigger to assume its upright position and again share the weight of the load.

The use of the truck is subject to certain stipulations; namely, the hay must be partially cured to overcome the danger of spoilage. Hay ready to go into the cock is in the most desirable state to place on the truck. Vester S. Mullins, a Mississippi farmer, applies this method:

"When the yield is light, say about ½ ton per acre, the hay is mowed in the morning, raked in the afternoon, and put on the trucks in the evening, or the next morning after the dew is off. When the yield is about 1 ton per acre, hay is mowed in the morning, and tedded the next morning and raked into windrows before dinner. The hay is allowed to lie in the windrow only two hours before being put on the trucks."

A two-man crew can load fourteen trucks in ten hours, while three men can load twenty trucks in a corresponding period of time. It is advisable to convey a train of six or ten trucks to the field to the extent of a day's supply. This practice will avoid a waste of time necessary in bringing trucks from a distance.

Loading the Truck

After loading the first truck the sides of the load are raked down with pitchforks to insure a sort of gutter for rainfall. The canvas is spread on the load and tied at the four corners. This task is accomplished while the team is being hitched to the second truck. The canvas is put on regardless of the prospect of rain. The loaded truck is left standing where the last hay is put on. The hay can remain on the truck indefinitely.

Twenty-five trucks and twenty-five canvases will entail an initial expenditure of $500, or a rate of $5 an acre on one hundred acres. The yield of alfalfa and Johnson grass hay in the South is three fourths of a ton per cutting when the field is cut four times a year. One hundred acres will yield 75 tons per cutting. It is estimated that the life of the truck is of sufficient length to guarantee 120 tons of cured hay.

The curing truck eliminates all danger of the hay spoiling, either by loss of color or quality, after it has been put on the truck in proper condition and is properly protected by a good canvas cover. With hay selling at $20 a ton, assuming the cost of a truck to be twenty-four cents per ton handled, the cost of using a truck in harvesting a ton would be repaid by the saving of an additional twenty-four pounds of hay.

Opinion of an Expert

"Unfavorable weather during the haying season causes a loss to the grower in two ways," says a farm expert. "The first is due to the loss sustained by undue exposure of the hay to sun and rain. This includes the loss of color, which may be caused by either rain or sun and results in lowering of the selling price. The loss may go farther than simply loss of color. Hay in the cock may become moldy and unfit for feeding. Continued handling will cause a high percentage of leaf loss in alfalfa and other legume hay, which lowers its total nutrients.

"The second loss is due to the extra work involved when it becomes necessary to handle the hay to prevent spoiling. When hay in the cock becomes wet through with rain, it is necessary to open the cocks and spread out the hay to prevent heating. Sometimes it is necessary to recock the hay after it has been spread out, and finish the curing in the cock. This extra labor increases the cost of making hay, and thereby decreases the profits."

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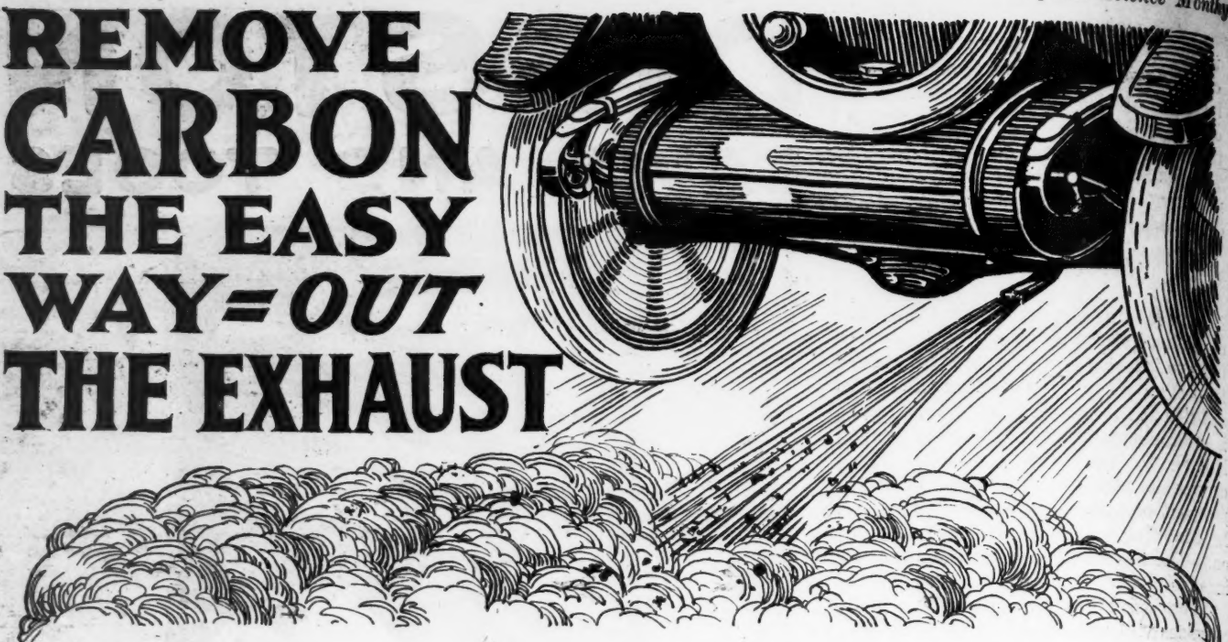

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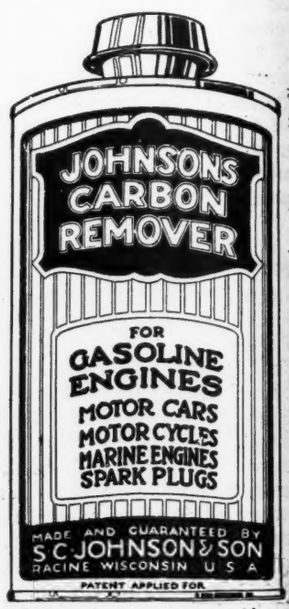

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JUNE, 1919

Volume 94-No. 6

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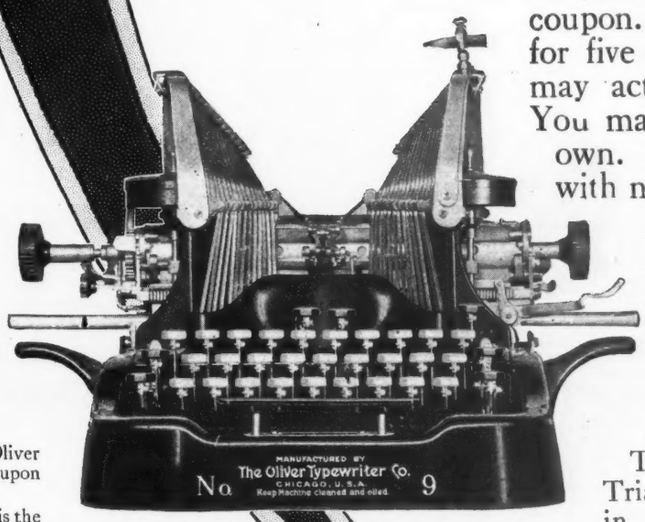

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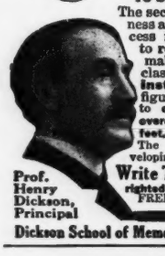

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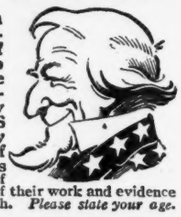

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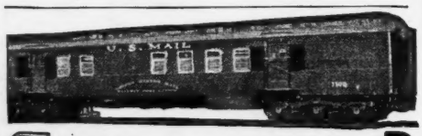

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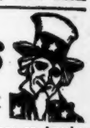

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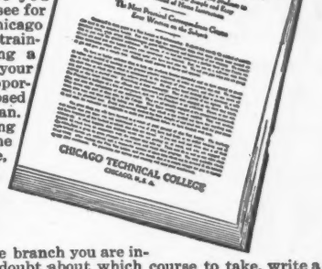

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BUILD your own phonograph. Big saving. Pleasant, instructive work. Complete instructions, blue-prints, etc., absolutely free. Write today. Associated Phonograph Company, Dept. F1, Cincinnati, Ohio.

BUILD phonographs we furnish motors, tonearms, cabinet material and blue prints. 3-cent stamp for catalog. Belltona Company, North Tonawanda, New York.

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MAIL us 15c with any size Film for development and 6 velvet prints. Or send 6 negatives any size and 15c for 6 prints. 8x10 mounted enlargements 35c. Prompt, perfect service. Roanoke Photo Finishing Co., 212 Bell Avenue, Roanoke, Virginia.

OUR Regular Prices, Prints, 3c Each. Developing 5c Roll. Any Size. One trial that's all we ask. You'll come back for more. Photo Service Shop, 929 McMillan, Cincinnati, Ohio.

SEND today for most complete camera and photographic catalog; worth its weight in gold—but free to you! David Stern Company, Chicago, U. S. A. In business since 1885.

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SPECIAL Trial Offer. Your next Kodak film developed 5c. Prints 2c each. Moser & Son, 1818 St. James Avenue, Cincinnati, Ohio.

KODAK Films developed, any size, 5c each. Prints any size, 3c each. Superior service. L. Company, 286 Ludlow Avenue, Cincinnati, Ohio.

OLD, Reliable House. Rolls developed Free. Prints, 2½c. and 3½c. Enlargements, 15c. to 35c. Virginia Art Company, 717½ Pine Street, Richmond, Virginia.

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GOIN' Fishin'? Make sure of big catch. Our Guaranteed Bait does the work. Bait free. Agents wanted. Write Western Mfg. Company, 121, Hannibal, Missouri.

FISH, AQUARIUMS, SUPPLIES

LEARN about Gold Fish. Imported Japanese and American gold fish, aquarium plants, food, cement castles, snails. Artistic aquariums for beautiful homes, conservatories, lawns; special aquariums made to order. Catalogue free. Pioneer Aquarium Company, Racine, Wisconsin.

DOGS, BIRDS, PETS

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

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$5.00, $10.00, $15.00. We buy second-hand watches. Seven, fifteen and seventeen jeweled grades, $5.00, $10.00 and $15.00. They are used for our foreign trade. We also want old watches for the movement parts to use in our repair and material department. We report the same day watches are received. Send your watch today. Rogers-Thurman & Co., Jewelers' Wholesale Supply House, Established 30 years, Dept. 104, Mailers Building, Chicago, Illinois.

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MONEY-MAKING farms—17 states—$10 to $100 acre. Stock, tools, crops often included to settle quickly. Write for big illustrated catalogue. Dept. 12, E. A. Strout, Farm Agency, New York.

CALIFORNIA little farms, near Los Angeles, for sale. Easy payments. Write E. R. Waite, Shawnee, Oklahoma.

THE Real Estate Educator—A Book for hustling real estate boosters, promoters, town builders and every man who owns, sells, rents or leases real estate. Covers fully Workmen's Compensation Act, Income Tax Law, Employer's Liability Act, Statute of Frauds, How to Sell Real Estate, How to Become a Notary Public or Commissioner of Deeds, "Pointers," "Don'ts" and other information. 256 Pages, Cloth, Price, $1.50. Book Department, Popular Science Monthly, 225 West 39th Street, New York.

PROGRESSIVE Corporations Seeking Rest Camps suburban to Chicago for contented employees. Address Manning, Owner, Warrenville, Illinois.

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BE a Top Notcher. Get into the 100% Class. Be Prosperous, Powerful, Happy. Our system has shown thousands how. It can show you. No guess-work. Proved. True-to-life Personality Sketch and first lesson on Happier Living for 10c and birth date. Thomson-Heywood Company, 700 Chronicle Building, San Francisco, California.

INDIAN Baskets—Wholesale and retail. Catalogue. Gilham, Highland Springs, California.

CATCH Fish Every Trip! Information for stamp. George Julian, Albany Building, New York.

YOU will find the Student Help Bureau's ad under "Help Wanted" mighty interesting.

GET vital strength—Retain youthful vigor. Simple, easy, sure. Particulars free. Winslow E. Chase, Washington, D. C.

"SEXUAL Philosophy," 12c. Clear, specific, authoritative, complete, best satisfies. Fred B. Kaessmann, Lawrence, Mass.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

DO You Want Hair? You can have it by using The Ekdee Hair Cerate. 95% of baldness curable. Thin hair made thick. (Not a dye.) Two months trial sent postpaid for $2.10. The Ekdee Company, 800 Union Avenue, North, Portland, Oregon.

MEN'S and women's hats cleaned and blocked. Write for price list "A." Gluck's Hat Cleaning Company, Birmingham, Alabama.

DREDGE'S Necktie Valet removes wrinkles (without ironing) from neckties. Sample 25c. Get one today. 190 Pilgram Avenue, Highland Park, Michigan.

BOOKS AND PERIODICALS

BOOKS—All out-of-print Books supplied, no matter on what subject. Please state wants. Baker's Great Bookshop, 14-16 John Bright Street, Birmingham, England.

KAISER Bill's letter to Otto. A scream—with Book Catalogue free. Byron, B. 27, Station I, New York.

NATURE Book—facts every married and engaged person should know; 35c. Central Company, 599 Ninth Avenue, New York.

INSTRUCTION Book (for shop use) on Vulcanizing Auto-Tires, $1. Tire Equipment Company, 368 8th Street, Cincinnati, Ohio.

USED Books. Bargains. Catalog. Higenes, K-2441 Post, San Francisco. (Books Bought.)

CONCORDIA Magazine contains original essays, formulas and mail order plans. Sample copy, 15 cents. Concordia Magazine, York, Pennsylvania.

AGENTS AND SALESMEN WANTED

WE start you on the road to a successful and independent career. You can't fail—$8 to $15 a day the year around. Exclusive territory—direct representative. Largest manufacturing concern—exceptional products—not sold in stores. Needed by every member in every home—repeat orders all year round. This is no time for doubters—come join this successful organization at once—Men and women—We are back of you with thousands of dollars. T. H. Snyder & Company, 43 Third Street, Cincinnati, Ohio.

UNDERWOOD & Underwood, the world's leaders in illustrative material are now making exclusive territory contracts for the sale of Visual Instruction Equipment to schools and libraries—big money to high-class, educated men. References and cash deposit required. Underwood & Underwood, Dept. P. S., 417 5th Avenue, New York.

WANTED—Superior agents for superior made-to-order Raincoats. Entirely different from the ordinary kind. Make $5 to $15 daily. You sell; we deliver and collect. Get facts today. Desk 43, Superior Raincoat Company, Dayton, Ohio.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrite Company, 1115 Second Avenue, New York.

SALESMEN—City or Traveling. Experience unnecessary. Send for list of openings and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment service rendered Members. National Salesmen's Training Association, Dep't 126 G, Chicago, Illinois.

SALESMEN—Energetic, to visit schools; $100 salary and liberal commission. R. O. Evans & Company, 1100K Wabash Avenue, Chicago.

EASY, pleasant work for Mechanics, Shop Men, Clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Co., 27 Bar St., Canton, Ohio.

WONDERFUL Adding Machine—Seven column capacity—retails for one dollar. Sells itself everywhere. Most offices purchase several. Sensational agency proposition. L. J. Leishman Co., Dept. F, Ogden, Utah.

$50.00 a Week and your own suit free. A wonderful offer to advertise our classy tailoring. All extras free—delivery charges prepaid—Self measuring blanks, style charts, sample book, etc., free. Send no money. Just write your name and address on a postal. American Woolen Mills Company, Dept. A51, Chicago.

AGENTS earn $30 and up per week in spare time selling "Maketia Guaranteed Woolen Army Blankets"; 100,000 sold U. S. Government, not one rejection; every home and club a prospect; sells for $4.00. Write for full information; greatest blanket value on the market. Maketia Co., 611 R-41, Drexel Building, Philadelphia, Pennsylvania.

AGENTS; Earn $25 to $100 weekly selling our home necessity. Every home a prospect. Over 50,000 sold without a complaint. Excellent proposition to reliable parties furnishing references. Exclusive territory. Shafer Mfg. Company, Dept. G, 6248 Evans Avenue, Chicago.

AGENTS: $5.00 hourly absolutely guaranteed. Gasoline two cents gallon. Money back guarantee. Write Federal Chemical Works, 20 West Jackson, Chicago.

$40 to $100 a week. Free samples. Gold sign letters anyone can put on windows. Big demand. Liberal offer to general agents. Metallic Letter Company, 431A North Clark, Chicago.

WERE You Ever Offered a Grocery Store? Our Proposition is Better. Let us tell you how you can handle Flour, Canned Goods, Provisions, and entire line of groceries, as well as Paints, Roofing, Stock, Foods, Automobile and Machinery Oils and Greases. No rent to pay. No investment in stock. Large orders taken from samples. Goods of guaranteed and proven quality. Selling experience not necessary. Very profitable work for "workers." Address Hitchcock Hill Company, Dept. 220, Chicago, Illinois. Reference: Any bank or express company.

INSYDE Tyres, inner armor for Automobile Tires, prevent punctures and double mileage of any tire. Liberal profits. Details free. American Accessories Co., Dept. 97, Cincinnati, Ohio.

KEROSENE Burners for Furnaces, Cook and Heating Stoves. Economy Mfg. Company, 616 West Monroe, Chicago.

300% Profit—Agents clearing hundreds weekly. New washing compound. Wonderful seller. Big repeater; Nature's mightiest cleanser. Send for proof; free sample. Fred D. Mitchell, 1314 E. 61 Street, Chicago.

$2.50 per day paid one representative in each town to distribute free circulars and take orders for concentrated flavoring in tubes. Permanent position. F. E. Barr Company, 627 Lowell Building, Chicago.

AGENTS: Sell rich looking 36x68 imported rugs, $1.00 each. Carter, Tenn., sold 115 in 4 days; profit, $57. You can do same. Write for sample offer selling plan; exclusive territory. Sample rug by parcel post prepaid, $1.19. E. Condon, Importer, 12 Pearl Street, Boston, Massachusetts.

AMAZING new invention, marvelous adding machine. Retails $10. Adds, subtracts, multiplies, divides automatically. Does work of $300 machine. Five-year guarantee. Offices, stores, factories buy from one to dozen. Every demonstration sells. Liberal profits. Write quick for protected territory and trial offer. Calculator Corporation, Grand Rapids, Michigan.

BIG Money selling Non-alcoholic Flavorings, Egg Conserver, Toilet Preparations, all repeaters. Agents' outfit free. Fletcher Production Company, 317 Clinton, Chicago.

OUR New Inventions earn you steady income. Canvassers, County Rights, Salesmen and Promoters write. Adam Fisher Mfg. Co., 1830S, St. Louis, Missouri.

AGENTS: Big money selling great household invention. Sample 25c. Particulars free. Webster & Company, 2935 North Clark Street, Chicago.

DROP everything else! Sell guaranteed silk hosiery and underwear all or spare time; direct from factory to consumer. Big money maker. Big commissions. Prompt deliveries. C. & D. Company, Dept. 10, Grand Rapids, Michigan.

LYNER Tyres—Inside protectors for automobile tires, prevent punctures and blowouts. Tremendous demand. Big profits. Write for money-back proposition. Pelletier Rubber Company, Box 322, Cincinnati, Ohio.

$300.00 monthly selling best standard brand tires at wholesale prices to consumer. J. Simons, 2204 Michigan Avenue, Chicago.

AGENTS make 500% profit handling auto monograms, new patriotic pictures, window letters, transfer flags and novelty signs. Catalog free. Hinton Company, Star City, Indiana.

AGENTS—200% profit! Wonderful summer sellers; something new; sells like wildfire; carry in pocket; write at once for free sample. American Products Company, 915 American Building, Cincinnati, Ohio.

300,000 sold in one month—agents who know their business can reap a rich harvest selling "General Pershing's official story of the American Expeditionary Forces in France." Wherever Pershing's name is known you have a sale. Every page illustrated in colors. Contains "In Flander's Field" and "An Answer"—beautifully illustrated in two colors—sells for 25c—liberal terms. Write Herzig & McLean, Inc., 1202 Centurian Building, New York.

SPIRAL Curtain Rods; big sellers; other specialties. Circulars free. Moore Company, 200 Jerome Avenue, Cincinnati.

AGENTS—Something different! Our Eradium (Luminous) Crucifix, actually shines in the dark. Startling! Mysterious! Wonderful! Enthusiasm follows every demonstration. 150% profit on every sale. Sole manufacturers. The Pioneer Corporation, 1263 West 63rd Street, Chicago, Illinois.

AGENTS earning $40 to $100 a week on live subscription proposition on well-known national publication exclusive in field. Live wires secure permanent position as district managers on salary. Write Collins, 406 State Lake Building, Chicago.

MEN operating Sugar Puff Waffle Machines earn $35-$70 daily. Machines priced $25 to $150 on trial. Talbot Mfg. Company, 102, St. Louis, Missouri.

WONDERFUL New Chemical. $1.00 Package equal 50 gallons gasoline. Eliminates carbon. 50% more mileage, power, speed. Guaranteed. Whirlwind seller. Auto owners buy on sight. 100% profit. Repeater. Demonstrating package, terms, territory, 10c postage. Myers & Company, 36 Baird, Cambridge, Ohio.

AGENTS: Marvelous dye soap; brilliant, fast colors; quick, big profits; $75 weekly on repeat orders; women amazed; buy regularly; Egyptian Queen Dye Soap a wonder; dyes silk, cotton, wool, one minute; absolutely different; beautiful colors, light or dark; no boiling; will not stain hands; perfect results; no experience necessary; all or spare time; write today; wonderful offer; Other Valuable products. Address, Peerless Products Company, Dept. 315, 618 West Jackson Boulevard, Chicago, Illinois.

FIVE Volume complete History World's War. Agents can double commissions, best authorship, most complete. Also one volume edition; both colored illustrations. Exclusive territory, expensive prospectus, both volumes 50c. L. Thomas Publishing Company, 509 Wabash Avenue. Chicago, Illinois.

ENORMOUS profits applying transfer monograms to automobiles, trunks, bags, etc. Easily and quickly applied to anything. No experience. No paints or laborious hand-lettering. Sample free. Wagner Company, Corona, New York.

AGENTS—Our Spray Auto Washing Brush sells to all auto owners. Attaches to garden hose. Retails $3.50. Commission 40%. Sample $2.00 postpaid. Sanitax Company, 2314 Wabash Avenue, Chicago.

CHEAP but essential accessory for Ford and Chevrolet cars. Sells to car owners. Agent's profit $4.00 to $5.00 each. Sample $1.00, but send no money. Will send on approval. Return if not satisfied. Hill-Smith Metal Goods Company, 82 Brookline Street, Boston, Massachusetts.

THE NEWEST and best Accident and Sickness Insurance. $5,000.00 death and $25.00 weekly benefits cost but $10.00 yearly. Eight different policies to meet every requirement. Men and women, between 16 and 69 years insurable. $100 Identification Certificate in heavy Leather Wallet with each policy. Wonderful opportunity for agents with permanent renewal commission. $1,000,000.00 asset company licensed in your state. Write for policy or agency. Horace B. Meininger, Manager, 308 Walnut Street, Philadelphia, Pennsylvania.

WANTED: Man with auto in every section to sell our Big Six-In-One tool, comprising vise, pipe vise, anvil, drill press, cutting hardie and corundum grinder. Every farmer, janitor, private or public garage, small shop, etc., a prospective buyer. Outfit weighs 90 pounds, sells for $20 with a fat profit to you. No trick to sell. Always pleases. Write Chicago Flexible Shaft Company, Dept. H. W. 5600 West 12th Street, Chicago.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, New York.

MEN and Women—Become independent—own your business, experience unnecessary selling our $6,000 Accidental Death, $30.00 Accident, $25.00 Sick Weekly Benefits, $10.50 yearly, half amounts $5.50. Guaranteed steady income from renewals. $250,000 deposited Insurance Department. Registration Dept. S., Newark, N. J.

VULCANIZING auto-tires growing profitable business especially now. Easy to learn. Instruction book $1. Plants $50 up. Catalog free. Equipment Company, 372 8th Street, Cincinnati, Ohio.

"RADIO" Luminous Paint for resale. Big demand—big profits. Trial can 50c delivered. American Luminous Products Co., Huntington Park, California.

MAKE and Sell Your Own Goods. Machinery unnecessary. Expert Chemists advise. Special attention to beginners. Write for Formula Catalog. Elmer Mystic Company, Washington, D. C.

ENORMOUS profits selling Duo Guaranteed Products. Easy sales at every house. All or spare time. Outfit Free. Write quick. Duo Company, Dept. H66, Attica, New York.

WANTED—Superior Agents for Superior made-to-order Raincoats. Entirely different from the ordinary kind. Make $5 to $15 daily. You sell; we deliver and collect. Get facts today. Desk 43, Superior Raincoat Company, Dayton, Ohio.

MAKE $30 next Saturday. Agents—Salesmen—brand new invention selling like wildfire everywhere. Sell Speederator for Fords—so good it's used by 17 officials Ford Motor Company. Makes any Ford run like a Packard. Put on quick—no tools—no holes to bore. Instant satisfaction. Big profits quick—sell ten to twelve a day easy. McAllister, Ill., sold four first afternoon; profit $12. Exclusive territory to hustlers. Write quick for details. Address Perrin Metal Parts Company, 985 Hayward Building, Detroit, Michigan.

$10.00 to $25.00 a day profit! Biggest summer seller. Concentrated fruit drinks. Just add water—delicious drink in a jiffy. Six popular flavors. Bestever Products Company, 2426-P6 Polk Street, Chicago.

TRAVELING men make big money. We teach and guarantee position. Write Box 255, Miltonvale, Kansas.

THE Master Key is better than a whole bunch of ordinary keys. Every house owner should have one. Sent postpaid on receipt of 20c. Agents wanted. Sharpe Mfg. Company, Paterson, New Jersey.

AGENTS wanted to sell sanitary necessity for every community—large sales, liberal commissions. In replying give experience, goods sold and territory desired. Dept. P.S., Dail Street Products Company, Lansing, Michigan.

NEW invention—Big seller. Devlin Company, P. O. Box 433, Newark, New Jersey.

$1,000 per Man per County; Strange invention startles world—agents amazed. Ten inexperienced men divide $40,000. Korstad, a farmer, did $2,200 in 14 days. Schleicher, a minister, $195 first 12 hours. $1,200 cold cash, made paid, banked by Stoneman in 30 days; $15,000 to date. A hot or cold running water bath, equipped for any home at only $6.50. Self-heating. No plumbing or water-works required. Investigate. Exclusive sale. Credit given. Send no money. Write letter or postal today. Allen Mfg. Co., 476 Allen Bldg., Toledo, Ohio.

SALESMEN—New carburetor for Ford Cars. Simple, not a moving part, installed in thirty minutes, guaranteed to double your mileage and start in zero weather without heating or priming. 15 day free trial. Our St. Louis man sold 1400 in 6 months, Salt Lake City man made $1200.00 in one week. Write U. & J. Carburetor Co., 505J West Jackson Boulevard, Chicago.

REMARKABLE Stretching Cuff Links—Permit cuffs to be raised over elbows quickly, without unbuttoning. Durable, invisible, everlasting. Big profits for competent district agents selling direct to wearers. Flexo, P. S. Sheboygan, Wisconsin.

AGENTS: Quick seller—big profits. California Rosebeads selling like hot-cakes. Women wild about these beads. Write today. Mission Bead Company, X2819 W. Pico, Los Angeles, California.

GOING to advertise? Success or failure depends upon your knowledge of the business. Get started right. Competent advice gladly given by one who knows. Douglas Wakefield Coutlee, 227 West 39th Street, New York.

1919 Line of Globe Transfer Initials for monogramming automobiles just off press; exceptional profits to agents and salesmen. Samples and display board 10c. Particulars free. Globe Decalcomanie Mfgrs., Jersey City, New Jersey.

AGENTS: Big pay and free automobile introducing wonderful new gasoline saver, puncture roof, five year spark plugs and other economical auto necessities. Outfit free. L. Ballwey, 190, Station F., Louisville, Kentucky.

AGENTS make $50 weekly selling Accident and Sickness Policies for $10 yearly. Pays $5000 death, increasing to $7500, also $25 weekly benefit for accident or sickness. Quick claim settlements. Permanent income from renewals. $100,000 deposited with State. Address Insurance Company, Dept. 7-J., Newark, New Jersey.

MAN in each town to refinish chandeliers, brass beds, automobiles, by new method. $10 daily without capital or experience. Write Gunmetal Company, Avenue "F", Decatur, Illinois.

PATENTS. Write for Free Illustrated Guide Book. Send sketch or model for free opinion of its patentable nature. Highest references. Prompt attention. Reasonable Terms. Victor J. Evans & Co., 174 Ninth, Washington, District of Columbia.

SALESMEN, high grade, for state and county agencies; practical device rings electric bells forever without batteries; made by leading manufacturer. Sound, permanent, business; men are already making good money; territory being rapidly assigned; references and previous experience essential. Betts & Betts Corporation, Betts Building, 42nd Street, New York.

MIRACLE Motor-Gas amazes motorists. 3c worth equals gallon gasoline. Eliminates carbon. 300% profit. Isom, Idaho, wires: "Ship 500 packages. Made $70 yesterday." Samples free. Chas. A. Butler, Secretary, Dept. 60, Toledo, Ohio.

233% Profit selling Jubilee Spark Intensifier. Banishes spare plug trouble. Sells like wild-fire. Exclusive territory. Write quick. Jubilee Mfg. Company, Omaha, Nebraska.

AGENTS—$60 a week to travel by automobile and introduce our 200 candle power coal-oil lantern. Write for particulars of our free auto offer. Thomas Company, 861 North Street, Dayton, Ohio.

AGENTS: Make Big Money Selling "Mechanics Guide Hand Book" to Machinists and Automobile Owners. Sells on sight. Send 25c. for sample copy. North American Book Company, Central National Bank Bldg., St. Louis, Missouri.

BEGINNERS—Complete "Mail Order System." Address Box 1005, Atlantic City.

AGENTS—Fine income, 100 per cent. profit, selling the Marvelous Chemical Gas Lighter. No spark, no friction. Turn on gas, lights itself. Sample 20c. Illuminal Corporation, 64 Murray Street, New York.

FARM with your Ford. Do 2 days work in 1. Agents make $100 weekly. Money back guarantee. Write, today for free circular. Geneva Tractor Company, Dept. 24, Geneva, Ohio.

SALESMEN—Why Not Offer Your Customer Advertising pencils imprinted with their name in gold. One gross and up. You'll sell every prospect! Write for our pocket case that pays big commission. O.K. Pencil Company, Louisville, Kentucky.

AGENTS answer first! What Kilem will do? Greatest scientific discovery of the age; 10th year. Instant death before your eyes, roaches, flies, bedbugs, etc. Outfit, territory free. C. Newlyn, New Castle, Delaware.

GAMES AND ENTERTAINMENT

TRICKS and Greenbacks. Big magic catalog 5c, Twenty greenbacks—10c. Gilmagico, 11135 South Irving, Chicago.

1,000 stage tricks with 500 illustrations. Catalogue 10c., small catalogue free. Hornmann Magic Co., Sta. 17, 470 Eighth Avenue, New York.

TRICKS, Puzzles, Jokes, Toys, Games, Novelties, Dolls and Cane Racks, Plays, Wigs, Stage Supplies, Escapes and Illusions. Large 1918 Catalog Free. Oaks Magical Company, Dept. 555, Oshkosh, Wisconsin.

GO on the stage or moving pictures! Experience unnecessary. Particulars free. Director, Box 397, Philadelphia, Pennsylvania.

TRICKS, Puzzles and Novelties. Catalog Free. Ben Zitka, Fairview, Massachusetts.

AGENTS—Sell latest joke novelties. 20c brings latest novelty and wholesale prices. Mears, 66, Anderson, Indiana.

SCENERY—Flags and artistic decorations for hire. Amelia Grain, Philadelphia.

PICTURES AND POSTCARDS

PRESIDENT WILSON'S Portrait—An exceptionally beautiful production; Size 17½x25 inches. Suitable for framing. Send 25c for one. Quantities at a lower price. Columbia Planograph Company, Washington, D. C.

JOIN Live Postcard Club. Membership Papers 10c. Harvey Teeple, Decatur, Indiana.

DO you like pictures? Prove it! Send your name, write plainly, and no money. O. W. Miller, C105 Chambers Street, New York.

PATENTS AND INVENTIONS WANTED

WILL buy any useful patent. Send details. International Specialty Mfg. Company, Spingarn Building, Jersey City, New Jersey.

Quick-Action advertisements continued on page 12

How to Increase Your Will Power In One Hour

Author of This Article Tells How He Quickly Acquired a Dominating Will Power that Earns Him Between $50,000 and $70,000 a Year

FOUR YEARS ago a man offered me a wonderful bargain. He was hard up for money and wanted to sell me some shares in a young, growing company for $1,000. Based on the earnings of the Company the stock offered me was easily worth $5,000—in fact, the man who finally bought the shares sold them again in five months *at a profit of* $4,300.

The reason I didn't buy the shares was that I could no more raise a thousand dollars than I could hop, skip, and jump across the Atlantic Ocean. A thousand dollars! And my income only twenty-five a week.

The second chapter in my life began a few months later, when another opportunity came to me. It required an investment of $20,000 during the first year. I raised the money easily, paid back every penny I borrowed, and had $30,000 left at the end of the first year! To date, in less than four years, my business has paid me a clear profit of over $200,000 and is now earning between $50,000 and $70,000 a year. *Yet for twelve years before, the company had been losing money every year!*

The natural question for my reader to ask is, "How could you borrow $20,000 to invest in a business which had previously been a failure, after being unable to borrow $1,000 for an investment that seemed secure?" It is a fair question. And the answer can be given in two little words—*WILL POWER.*

Partial List of Contents

The Law of Great Thinking.
The Four Factors on which it depends.
How to develop analytical power.
How to think "all around" any subject.
How to throw the mind into deliberate, controlled, productive thinking.
Detailed directions for Perfect Mind Concentration.
How to acquire the power of Consecutive Thinking, Reasoning, Analysis.
How to acquire the skill of creative Writing.
How to guard against errors in Thought.
How to drive from the mind all unwelcome thoughts.
How to follow any line of thought with keen, concentrated Powers.
How to develop Reasoning Power.
How to handle the mind in Creative Thinking.
The secret of Building Mind Power.
How the Will is made to act.
How to set your Will.
How a strong Will is Master of Body.
What creates Human Power.
The Six Principles of Will Training.
Definite Methods for developing Will.
THE NINETY-NINE METHODS for using Will Power in the Conduct of Life.
Seven Principles of drill in Mental Physical, Personal power.
FIFTY-ONE MAXIMS for Applied Power of Perception, Memory, Imagination, Self-Analysis, Control.
How to develop a strong, keen gasp.
How to concentrate the eye upon what is before you—object, person, printed page, work.

These are only a few of the many subjects treated.

When the first proposition came to me I passed it by simply because I didn't have the money and couldn't borrow it. I went from one friend to the next and all turned me down. Several refused to talk business with me at all. They all liked me personally and they asked about the kiddies, but when it came to money matters I hadn't a chance. I was scared stiff every time I talked to one of them. I pleaded with them, almost begged them. But everybody had their "money all tied up in other investments." It was an old excuse, but I accepted it meekly. I called it hard luck. But I know today that it was nothing in the world except my lack of Will Power, or rather my weak Will Power, which kept me from getting what I wanted.

When I heard that the man sold those shares at a profit of $4,300, it seemed that my sorrow could not be greater. That profit was just about what my salary amounted to for four years! But instead of grieving over my "hard luck," I decided to find out why I was so easily beaten in everything I tried to accomplish. It must be that there was something vital that made the difference between success and failure. It wasn't lack of education, for many illiterate men become wealthy. What was this vital spark? What was this one thing which successful men had and which I did not have?

I began to read books about psychology and mental power. But everything I read was too general. There was nothing definite—nothing that told me *what to do.*

After several months of discouraging effort, I finally encountered a book called "Power of Will," by Prof. Frank Channing Haddock. The very title came to me as a shock. When I opened the book I was amazed. I realized that will power was the vital spark—the one thing that I lacked. And here in this book were the very rules, lessons, and exercises through which anyone could increase their will power. Eagerly I read page after page; including such articles as The Law of Great Thinking; How to Develop Analytical Power; How to Concentrate Perfectly; How to Guard Against Errors in Thought; How to Develop Fearlessness; How to Acquire a Dominating Personality.

An hour after I opened the book I felt like a new person. My sluggish will power was beginning to awaken. There was a new light in my eye, a new spring in my step, a new determination in my soul. I began to see, in my past, the many mistakes I had made, and I knew I would never make them again.

I practiced some of the simple exercises. They were more fascinating than any game of cards or any sport.

Then came an opportunity to acquire the business which had lost money for twelve years, and which I turned into a $50,000 a year money maker. Instead of cringing before the moneyed people, I won them over by my sheer force of will. I would not be denied. And my every act and word since then has been the result of my training in will power.

I am convinced that every man has within himself every essential quality of success except a strong will. Any man who doubts that statement need only analyze the successful men he knows, and he will find himself their equal, or their superior, in every way except in will power. Without a strong will, education counts for little, money counts for nothing, opportunities are useless.

I earnestly recommend Prof. Haddock's great work, "Power of Will," to those who feel that success is just out of reach—to those who lack that something which they cannot define, yet which holds them down to the grind of a small salary.

Never before have business men and women needed this help so badly as in these trying times. Hundreds of real and imaginary obstacles confront us every day, and only those who are masters of themselves and who hold their heads up will succeed. "Power of Will" as never before is an absolute necessity—an investment in self-culture which no one can afford to deny himself.

I am authorized to say that any reader who cares to examine "Power of Will" for five days may do so without sending any money in advance. If after one hour you do not feel that your will power has increased, and if after a week's reading you do not feel that this great book supplies that one faculty you need most to win success, return it and you will owe nothing. Otherwise send only $3, the small sum asked.

Some few doubters will scoff at the idea of will power being the fountain head of wealth, position and everything we are striving for, but the great mass of intelligent men and women will at least investigate for themselves by sending for the book at the publisher's risk. I am sure that any book that has done for me—and for thousands of others—what "Power of Will" has done—is well worth investigating. It is interesting to note that among the 250,000 owners of "Power of Will" are such prominent men as Supreme Court Justice Parker; Wu Ting Fang, Ex- U. S. Chinese Ambassador; Gov. McKelvie, of Nebraska; Assistant Postmaster-General Britt; General Manager Christeson, of Wells-Fargo Express Co.; E. St. Elmo Lewis; Senator Arthur Capper of Kansas and thousands of others. In fact, today "Power of Will" is just as important, and as necessary to a man's or woman's equipment for success, as a dictionary. To try to succeed without Power of Will is like trying to do business without a telephone.

As your first step in will training, I suggest immediate action in this matter before you. It is not even necessary to write a letter. Use the form below, if you prefer, addressing it to the Pelton Publishing Company, 14K Wilcox Block, Meriden, Conn., and the book will come by return mail. You hold in your hand, this very minute, the beginning of a new era in your life. Over a million dollars has been paid for "Power of Will" by people who sent for it on free examination. Can you, in justice to yourself hesitate about sending in the coupon? Can you doubt, blindly, when you can see, without a penny deposit, this wonder-book that will increase your will power in one hour.

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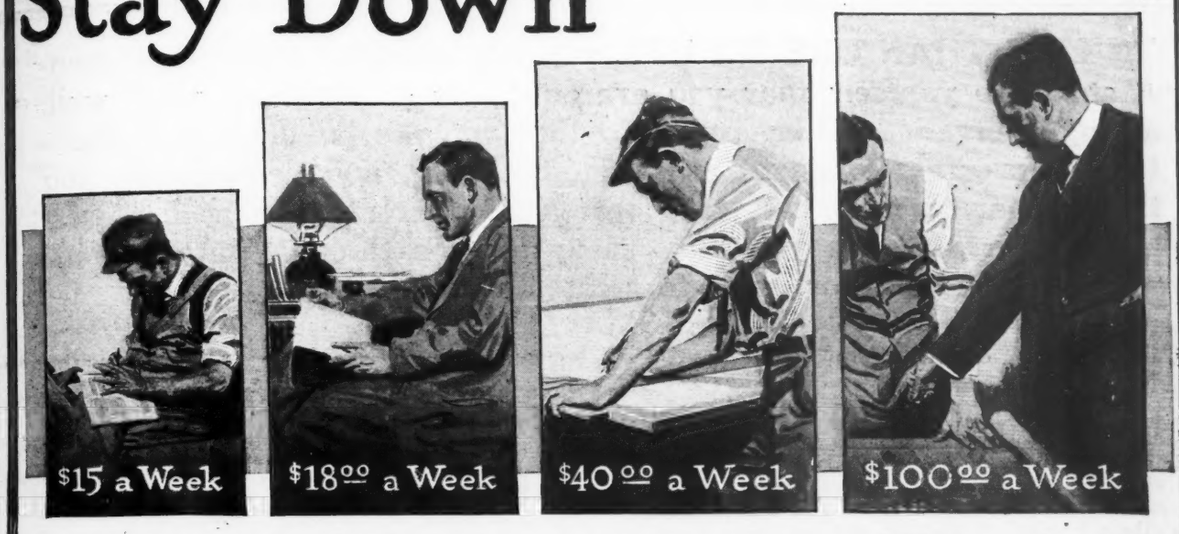
Quick-Action advertisements continued from page 10

The Man Who *Wouldn't* Stay Down



He was putting in long hours at monotonous unskilled work. His small pay scarcely lasted from one week to the next. Pleasures were few and far between and he couldn't save a cent.

He was down—but he *wouldn't stay there!* He saw other men promoted, and he made up his mind that what they could do *he* could do. Then he found the *reason* they were promoted was because they had special training—an expert knowledge of some one line. So he made up his mind that *he* would get that kind of training.

He marked and mailed to Scranton a coupon like the one below. That was his first step upward. It brought him just the information he was looking for. He found he could get the training he needed right at home in the hours after supper. From that time on he spent part of his spare time studying.

The first reward was not long in coming—an increase in salary. Then came another. Then he was made Foreman. Now he is Superintendent with an income that means independence and all the comforts and pleasures that make life worth living.

It just shows what a man with ambition can do. And this man is only one out of hundreds of thousands who have climbed the same steps to success with the help of the International Correspondence Schools.

What about *you?*

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Surely when you have an opportunity that means so much, you can't afford to let another priceless hour pass without at least finding out about it. And the way to do that is easy—without cost, without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

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Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

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Everywhere intelligent and smart men and women, in every walk of life, are secretly and privately advancing themselves in life, happiness, joy, power, health, and personality, through consciously employing the principles of evolution, by compelling their "creators" to work for them, strive for them, plan for them, evolutionize for them, and create for them, and to give them better and more vital and energetic bodies, and more intense and conscious personalities.

Only the "Masterful" Know the Joys and Pleasures of Life

Whether you are a doctor, farmer, lawyer, laborer, banker or soldier, business man or sailor, philosopher or scientist, greater success is waiting for you, through compelling your internal "creator" to build, construct and create for you.

Only the "Vital" Know the Pleasures and Joys of Real Success

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Only the "Mighty" Know the Pleasures of the Mighty

Your "creator" is ready to furnish you with higher power of mind and body, if you only make the demand in the way your internal "creator" understands and recognizes. Conscious Evolution uses the means and avenue through which the internal "creator" is reached positively, successfully, easily and conveniently, and without loss of time, compelling the internal "creator" to create for you just what you really desire, and really need, and really want. Your "creator" gives you the mind, the ideas, and the power to obtain what you want, if you activate your "creator" through the proper medium.

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Why deny yourself the super-joys, the super-pleasures and the super-happiness? Why deny yourself the best there is in existence? Why deny yourself these advantages when they are so easily available, and when it is so absolutely certain that you can attain them? Why, in other

Conscious Evolution

CONSCIOUS EVOLUTION must not be confused with Darwinian evolution or Physical Culture, nor should Conscious Evolution be confused with Hindoo philosophies, auto-suggestion, self-hypnosis, gymnastics, or mere physiology, anatomy, histology, theosophy, morphology, medicine, pathology, exercise, New Thought, Christian Science, calisthenics, embryology or psychology.

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Daily Results

"I owe my rise from the position of a country insurance agent to virtual head of one of the largest insurance companies of the world entirely to the power of personality Conscious Evolution has given me."

"My weak will and personality for years made it possible for my business partners to rob me of my proper share of the profits. Conscious Evolution gave me courage, self-reliance and power of personality, and I made my partners pay me $160,000.00 out of which they had bulldozed me during my feeble and powerless days."

"I became aware of the beneficial power of Conscious Evolution at the end of the first ten seconds."

"What more can I say except to express my appreciation of your method and sincere thanks for your interest and co-operation? What more can one want for so little? What more does one get in this world?"

"Conscious Evolution has taken away that tired, lazy feeling and replaced it with a feeling of energy—a feeling to do something and to take an interest in doing it. Truly, Conscious Evolution is a wonderful discovery. My experience with it enables me to say that it is all that is claimed for it and more."

"I am happy to say that I received your instructions, and that in spite of traveling a good deal my health is remarkable at ninety years of age."

"Conscious Evolution made me feel twenty-five years younger. I can run up and down stairs, and walk six or seven miles at any time. I rest and digest as I did in my youth. I have no worry and I feel happy. My arms and legs are getting strong, and I thank your System for it all. I have got along so well, I constantly think of going into the shipyard, to see what I can do. I want to stir around at something even though I am eighty-three years of age. Conscious Evolution is bringing me back to life. Conscious Evolution is bringing me back to youth. And I thank you, Mr. Swoboda."

"I would not take fifty thousand dollars for the power which in six weeks Conscious Evolution has given me."

"I am certain I am gaining in every way, for I feel as full of 'fight' and energy as a wild cat."

"Problems that formerly worried me are now as easy as to seem almost 'unreal,' since I gained power of personality through Conscious Evolution."

Swoboda 26 Years Ago

From a sickly youth Swoboda made of himself a magnificent physical specimen of the human race. This was just the beginning—his greater evolution was yet to come.

To Work for You

words, live the inferior life in preference to the superior—the genuinely successful life? Why cheat yourself of the advantages of life? Why deny yourself this super-energy, this super-power, and this super-activity of personality and mind, which is made easily and absolutely possible through progressive evolution—self-evolution—scientific evolution—personal evolution.

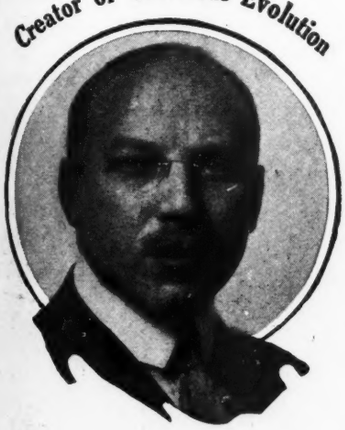
How to Gain What You Want

The way for you to gain what you want is by increasing your power of mind and body evolutionarily, so as to compel conditions to yield to your superior and irresistible energies. Conscious Evolution is the easy and sure means of making yourself supreme.

Why Be Satisfied with Inferior Life?

Why be satisfied or content with inferior vitality, inferior health, inferior energy, inferior digestion, inferior heart power, inferior lung power, inferior nervous system, inferior brain power, inferior memorizing power, inferior reasoning power, inferior sensing power, inferior scheming power, inferior business power, inferior conscious power, and inferior personal power? Why not attain the vital power of supremacy?

Creator of Conscious Evolution



Swoboda To-day

A Remarkable Personality

Swoboda, himself, is perhaps the most perfect example of what Conscious Evolution can accomplish. As Swoboda gains in years, he grows younger in enthusiasm, younger in vitality, younger in health; he is becoming stronger, more energetic, more confident, more dominant and more alive by capitalizing his creative powers through Conscious Evolution. What Swoboda is accomplishing for himself, you too can accomplish—every individual can accomplish, for every individual is governed by the same laws and principles, and every individual has it within himself to make use of these laws and principles. Swoboda's mind and body are so alert and so active that in his presence one feels completely overpowered. His personality dominates everything with which it comes in contact; yet Swoboda is real!—there is absolutely nothing mysterious about him. He knows not what fatigue is—he is a tireless worker. He delights in making sick people well and weak people strong. He loves his work because he feels he is of benefit to humanity—making a better, more vital, more potent race of men and women. Swoboda is not only a mental superman, but a high-powered physical dynamo, an unheard of combination.

More Daily Results

"A year ago I was down and out financially and physically. I was a wreck. Conscious Evolution gave me power of mind and health. I am to-day better than ever and I am more prosperous than ever. Naturally I am a believer in the Swoboda idea."

"Your system makes me feel like a different person. Every one whom I have ever met who has tried it out, has the same thing to say about it. Was talking to a man to-day whose wife is a Swoboda enthusiast."

"Your system is direct, simple, scientific, effective, and makes one feel so invigorated. As an athlete and a physician, I endorse Conscious Evolution unreservedly It is, and more, what is claimed for it."

"Conscious Evolution has given me surprising results. I expected good results, but I am surprised."

"Conscious Evolution sent a message of energy, health, and power through me in twenty seconds, which has been increased from day to day."

"Your course has been of great benefit to me. I am able to do a great deal more work with less fatigue. My pleasures are also increased; all work seems a pleasure now."

"I indeed realize what physiological gladness means. My sensation of physical enjoyment is wonderful. It seems too good to be true. It is something as I felt when I took my first trip to the Bermudas, where nature has combined the blending of dainty coloring so exquisite that nothing short of fairy land can describe it. This is how Conscious Evolution causes me to feel."

"I can honestly say that the benefits I have received from Conscious Evolution cannot be measured by any payment of money, and I can say unhesitatingly that your system far exceeded my fondest hopes."

"I could see the tremendous reality and possibilities of Conscious Evolution in less than half a minute's direction of my energies into creative channels."

"Conscious Evolution has changed me from an invalid into a tireless human machine."

"I would not consider trading the benefits I have received from Conscious Evolution for gold."

"As a student of physiology and histology, I at once recognized the feasibility of Conscious Evolution."

"Ten seconds from the time I started Conscious Evolution, I felt myself more alive and energetic."

"I have used Conscious Evolution for a few weeks, and I find myself marvelously improved in both body and mind. Conscious Evolution is wonderful, and the world will be brighter when men and women everywhere grasp it."

These Rare and Amazing Books Are For You

Swoboda has published for distribution two remarkable books which explain his system of Conscious Evolution and what it has already done. Write for these books—not because Conscious Evolution has meant so much to 262,000 other men and women, not because there is scarcely a prominent family in the country that hasn't at least one member a pupil of Swoboda, but because they contain valuable ideas for you. Conscious Evolution is being personally used by many of the most prominent physicians, and such men as Woodrow Wilson, Charles E. Hughes, the Rockefellers, the Vanderbilts, the Goulds, the Huntingtons, the Cudahys, the Armours, the Swifts, and McAdoos for advancing themselves in energy, health, vitality and power of personality.

Write for these books, because they mean so much to YOU in multiplied living power, earning power and personal power. They are filled from cover to cover with the vital facts about yourself and how you can acquire the degree of power in body and mind that you so consciously or unconsciously desire. They explain the dangers of excessive deep breathing, excessive exercise, and excessive muscular development, also the fallacy of conscious control of physiological processes.

CONSCIOUS EVOLUTION and THE SCIENCE OF LIFE show how to double or even treble your power of mind and body; not by tedious, prolonged study, but by a process of energization which raises the very level of your life and mental power.

CONSCIOUS EVOLUTION and THE SCIENCE OF LIFE supply the key to dominant personal power, dominant business power, dominant success power, dominant mental power and dominant will power.

Conscious Evolution is as effective for Women as for Men

They show how to change your aimless and fruitless life and attitudes into ambition, inspiration, enthusiasm and the higher success.

These books show how to amazingly increase your power of will and personality, as well as your power of body for every action, for every purpose and process.

Conscious Evolution is a new science, and no one can afford not to know at least the simple facts about it. These facts show how Conscious Evolution overcomes weak will, poor health, feebleness of mind and body.

They show how to overcome the inferior, pleasureless, feeble and unsatisfactory life by giving the means to the successful, superior and abundant life.

Conscious Evolution also shows how to arrest the aging of the body, and how to remain young, energetic, vigorous and active all of the days of life.

These books are absolutely free and there is no obligation now or after. These books are yours to keep, that you may attain a higher understanding of yourself and of Evolution and the means to a higher existence.

Even if you gain but one idea or the realization of the one principle of life through CONSCIOUS EVOLUTION and THE SCIENCE OF LIFE, these books will be of eternal advantage to you.

Just write your name and address on the coupon of this page, tear it out and mail it to Swoboda, or draw a ring around your name on your letterhead, or merely send a postal, giving your name and address. Do it today! This is your opportunity! Now is your turn! This is your day! This is your hour! Write now!

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WHITE OWL
Invincible
8c - 2 for 15c

Quoth Robust Texas to Old Penn State

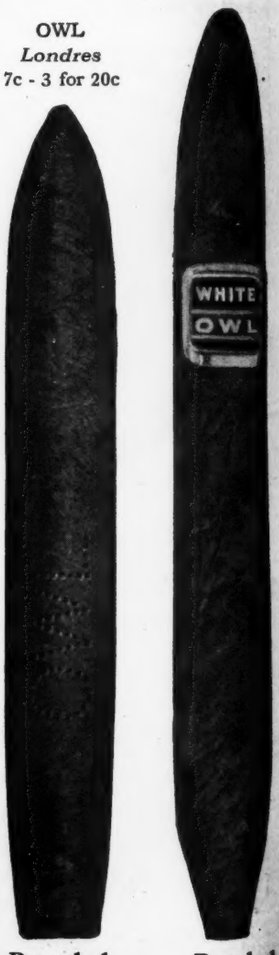
"HELLO, Pennsylvania, tucked 'way up there northeast. You sure are a busy fellow, though I s'pose you'd often like some room to breathe in. Why, I'm bigger than you and some of your neighbors put together. And look at my cattle and rice, my cotton! Have an OWL Cigar?"

Pennsylvania grinned indulgently as he lit his OWL.

"Texas, you big boy, you're certainly large and husky. But where would all your cotton be without the help of my knitting mills? Why, child, look at my coal, my steel, and my tobacco! And where would ***you*** be but for the Declaration of Independence—written in my Philadelphia!"

Dependable states, like dependable men, want dependable merchandise. They demand dependable cigars. That's why OWL and WHITE OWL sell big in Texas and Pennsylvania and every state between! Try each. Try both!

OWL
Londres
7c - 3 for 20c



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Ease the throat with—

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The many uses for Luden's have won year 'round popularity. Luden's quickly relieve huskiness, throat tickle, dryness and similar irritations. No matter who you are or what you do, you'll find Luden's helpful and handy.

Look for the familiar Luden yellow package

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Since 1881

GIVE QUICK RELIEF

COLGATE'S "HANDY GRIP" SHAVING STICK

PATENTED 1917

Mr. Jones writes a letter

—and his communication is interesting to every man who shaves himself—and wishes comfort in so doing.

"My children chanced to give me a stick of your shaving soap," says Mr. Jones. If you do not have one given you—give yourself a "Handy Grip."

"In the directions was an admonition not to rub . . . I thought this extremely silly," says Mr. Jones. But he tried it and found the truth of the original Colgate phrase used since 1807—"needs no mussy rubbing in with the fingers."

"I am, from now on, a firm champion of Colgate's Shaving Stick. It beats anything I have ever used," says Mr. Jones. You will reach the same conclusion after you have tried Colgate's "Handy Grip."

Colgate & Co., New York, April 6, 1918.
New York City.

Gentlemen:

Some months ago my children chanced to give me a stick of your shaving soap, and I am writing to you to tell you what a delight shaving now is with it, instead of the nightmare I formerly experienced whenever I shaved. The lather is wonderful, smooth as velvet, leaves the skin without any irritation, and in short, your shaving stick is ideal for the purpose.

In the directions that came with the shaving stick was an admonition not to rub the beard with the hand after applying the lather. I thought this extremely silly, but on trying it I found that your experts had solved another important element in successful shaving and I shall never again do anything but follow the advice given. The brush, applying the lather with the proper degree of moisture in it, is sufficient. The new method is vastly superior to the old.

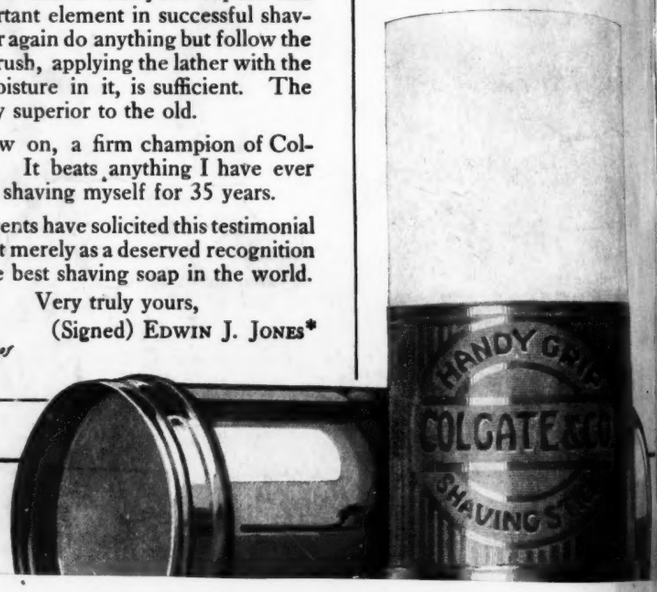
I am, from now on, a firm champion of Colgate's Shaving Stick. It beats anything I have ever used, and I've been shaving myself for 35 years.

None of your agents have solicited this testimonial from me but I send it merely as a deserved recognition of the makers of the best shaving soap in the world.

Very truly yours,
(Signed) EDWIN J. JONES*

*Mr. Jones is Associate Editor of The Financial World

THE "HANDY GRIP" is the thrifty Shaving Stick. It saves you 50 shaves below the "Waste Line," and more: you can buy a Refill Stick for the original metal Grip.



A DOUBLE ECONOMY WITH COLGATE'S

—for you can screw the last h inch of soap fr the Grip (enou for 50 shaves)—